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DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Betze Pit Expansion Project



BLM

Elko District Office - Nevada

August 2008

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Photo by S. Duncan May 22, 2007

United States Department of the Interior

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TAKE PRIDE IN AMERICA

In Reply Refer To:
3809 (NV-013)
NVN-070708

August 22, 2008

Dear Reader:

Enclosed for your review and comment is the Betze Pit Expansion Project Draft Supplemental Environmental Impact Statement (EIS) prepared by the Bureau of Land Management (BLM), Elko District Office. The EIS analyzes the direct, indirect, and cumulative impacts associated with the proposed extended mining and processing activities at Barrick Goldstrike Mines Inc.'s Goldstrike Mine in Eureka and Elko Counties, Nevada.

Comments should be postmarked or otherwise delivered to the Elko District Office by close of business October 6, 2008, to ensure full consideration. Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment - including your personal identifying information in your comment – may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public view, we cannot guarantee that we will be able to do so. Comments on the EIS can be sent to the above address, Attn: Kirk Laird.
A Final Supplemental Environmental Impact Statement will be prepared that will consider the comments received during the public review and comment period. If you would like any additional information, please contact Kirk Laird at (775)-753-0272.

Sincerely,

Kenneth E. Miller
District Manager

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DRAFT
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (SEIS)
BETZE PIT EXPANSION PROJECT

Lead Agency:	U.S. Department of the Interior Bureau of Land Management Elko District Office
Cooperating Agencies:	Nevada Department of Wildlife Elko County
Project Location:	Elko and Eureka counties, Nevada
Correspondence on this SEIS Should be Directed to:	Kirk Laird, SEIS Project Manager Bureau of Land Management Elko District Office 3900 East Idaho Street Elko, NV 89801-0611 (775) 753-0200
Date by which Comments Must be Received by the BLM:	October 6, 2008

ABSTRACT

Barrick Goldstrike Mines Inc. (BGMI), a wholly owned subsidiary of Barrick Gold Corporation, proposes to construct and operate the Betze Pit Expansion Project (Proposed Action), which would include the development of new facilities and expansion of existing open-pit gold mining and processing operations at the Goldstrike Mine located in north-central Nevada, approximately 25 miles northwest of Carlin in Eureka and Elko counties. The Proposed Action would include expansion of the existing Betze Pit, construction of the Clydesdale Waste Rock Facility and haul road, construction and operation of the Goldstrike No. 3 Tailings Facility, and extension of employment at the Goldstrike Mine for an additional 4 years. The Proposed Action would utilize some of the existing primary facilities, including ore processing facilities and ancillary support facilities.

The Proposed Action would result in surface disturbance on a total of 1,180 acres, of which 494 acres are public lands administered by the Bureau of Land Management and 686 acres are private land owned by BGMI. If approved, the anticipated mine life would be extended approximately 4 years through 2015, followed by an estimated 15 years for ongoing ore processing from stockpiles, and an additional 4 years for site closure and reclamation.

The Supplemental Environmental Impact Statement (SEIS) analyzes the environmental effects of the Proposed Action, one Alternative, and the No Action Alternative.

Responsible Official for SEIS:	Kenneth E. Miller District Manager Elko District Office

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EXECUTIVE SUMMARY

Executive Summary

Barrick Goldstrike Mines Inc. (BGMI), a wholly owned subsidiary of Barrick Gold Corporation, proposes to construct and operate the Betze Pit Expansion Project (Proposed Action), which would include development of new facilities and expansion of existing open-pit gold mining and processing operations at the Goldstrike Mine located in north-central Nevada, approximately 25 miles northwest of Carlin in Eureka and Elko counties. The Proposed Action would include expansion of the existing open pit (Betze Pit), construction of the Clydesdale Waste Rock Facility and haul road, construction and operation of the Goldstrike No. 3 Tailings Facility, and extension of employment at the Goldstrike Mine for 4 additional years. The Proposed Action would utilize many of the existing Goldstrike Mine facilities, including ore processing facilities and ancillary support facilities.

The Proposed Action would result in surface disturbance on a total of 1,180 acres, of which 494 acres are public lands administered by the Bureau of Land Management (BLM), and 686 acres are private land owned by BGMI. If approved, the anticipated mine life would be extended approximately 4 years through 2015, followed by an estimated 15 years for ongoing ore processing from stockpiles. The Proposed Action would accelerate reclamation of the existing Bazza Waste Rock Facility by 7 years compared with the No Action Alternative; reclamation of the Bazza Waste Rock Facility would be substantially completed by the end of 2011.

Under the Bazza Waste Rock Facility Alternative, the Clydesdale Waste Rock Facility and haul road would not be constructed, resulting in 572 fewer acres disturbed. The existing Bazza Waste Rock Facility would continue to be used and not fully reclaimed until 2018 (except for several existing ore stockpiles and an access road). All other aspects of the Bazza Waste Rock Facility Alternative would be the same as the Proposed Action.

Under the No Action Alternative, the proposed facilities that comprise the Betze Pit Expansion Project will not be constructed. BGMI will continue to recover gold at the existing facilities as currently authorized by the BLM and State of Nevada. Rodeo Creek will be diverted from its existing channel alignment north of the Betze Pit to a new alignment south of the pit to accommodate expansion of mining under current authorizations. Groundwater pumping in the area of the Betze Pit will continue through 2015 to maintain groundwater levels below the Meikle underground mine.

Rodeo Creek may be diverted into the Betze Pit at the end of mining as a closure option, under either the Proposed Action or the No Action Alternative, if approved by the State of Nevada.

Summary of Impacts Associated with the Proposed Action

The Proposed Action does not require dewatering of the Betze Pit; therefore, there are no resource impacts from dewatering under the Proposed Action. Pit dewatering impacts were addressed in the Betze Project Supplemental Environmental Impact Statement (SEIS) through year 2011. The potential impacts associated with dewatering operations for an additional 4 years, through 2015, from current State of Nevada authorizations for the Meikle underground mine are analyzed under the No Action Alternative. It is important to note that mine dewatering operations will occur regardless of the alternative selected.

Geology and Minerals

Direct impacts of the Proposed Action on geologic and mineral resources would include the generation and disposal of approximately 315 million tons of waste rock and 12.44 million tons of tailings; the removal of 0.5 million tons of Carlin Formation material suitable for reclamation use; and the extraction of 12.44 million tons of ore. Mined ore would be permanently removed from existing reserves. The Proposed Action would result in an extension of the permanent alteration of the landscape and disturbance of approximately 1,180 acres. This disturbance would include unreclaimed areas disturbed by the Betze Pit and reclaimed waste rock disposal areas and a tailings impoundment that would permanently alter the natural topographic and geomorphic features in the area. There is a low probability that ground motion would present a hazard at

the site. There are no identified geologic conditions that would be exacerbated by project activities and result in geologic hazards. The proposed waste rock and tailings facilities are not located in areas that have been susceptible to subsidence.

Groundwater Resources and Geochemistry

Following the completion of mining and the associated dewatering operations, groundwater elevations would rebound and eventually result in the development of a lake in the expanded Betze Pit. The pit lake is predicted to start forming approximately 14 years after the end of dewatering and to ultimately behave as a groundwater sink with no throughflow to the groundwater system. The development of the pit lake is predicted to be similar to the development of the pit lake described for the currently permitted pit under the No Action Alternative.

The results of the hydrochemical modeling of pit lake water quality were used to evaluate potential impacts to the Betze Pit lake water quality with and without diversion of Rodeo Creek into the pit at mine closure. Regardless of the closure option, the water quality of the expanded Betze Pit lake is predicted to be similar to the pit lake analyzed in the previous Betze Project SEIS at steady state (approximately year 400). The Proposed Action would have slightly higher concentrations of some constituents, including total dissolved solids, sulfates, and trace metals. Diversion of Rodeo Creek into the Betze Pit at closure would result in slightly improved water quality compared with no diversion of the creek into the pit. The expanded pit lake has predicted water chemistries that exceed some water quality standards under both closure options. The predicted water quality would meet Nevada wildlife propagation standards under both closure options. As discussed above, this pit lake is predicted to be a terminal pit lake and would serve as a groundwater sink.

Based on the geochemical tests conducted on potential waste rock from the proposed pit expansion area, the low percentage of potentially acid-generating (PAG) rock that would be placed in the Clydesdale Waste Rock Facility, the method of encapsulation of PAG rock within the facility, the cover design, and the proposed reclamation methods, acidic or metals-laden seeps are not expected from the proposed waste rock facility.

Construction design of the proposed Clydesdale Waste Rock Facility would be similar to the previously approved Bazza Waste Rock Facility. This design, including isolation of PAG cells and an evapotranspiration cover, limits the potential for seepage. Field observations and monitoring of the Bazza Waste Rock Facility over the past 15 years have shown no evidence of seepage. Therefore, surface water and underlying groundwater resources are unlikely to be affected by construction of the Clydesdale Waste Rock Facility.

Surface Water Resources

The Proposed Action is not expected to have a substantial impact on perennial streams in the project area. If approved by the Nevada State Engineer and Nevada Division of Environmental Protection, the closure option of diverting Rodeo Creek into the Betze Pit at the end of mining would not affect surface water quantity or quality because most runoff in Rodeo Creek is lost to seepage and evapotranspiration in Boulder Valley. The overall loss of contributing watershed (24 square miles) in the Boulder Flat Basin (560 square miles) represents approximately 4.3 percent of the basin. Since flows originating in the Rodeo Creek watershed do not contribute to downstream flows, the re-routing of Rodeo Creek into the Betze Pit would not cause a loss of surface water in Boulder Valley or the Humboldt River. No impacts to seeps or springs are expected from the proposed mine expansion activities.

No impacts to surface water quality are anticipated in association with the proposed waste rock disposal facility, haul road, or tailings facility based on the proposed Storm Water Pollution Prevention Plan, facility designs, reclamation procedures that would be implemented, and the 100-foot setback from Bell and Rodeo creeks. Implementation of runoff, erosion, and sedimentation best management practices would reduce these impacts to negligible levels during construction.

Soils and Reclamation

Approximately 1,180 acres of soil would be disturbed as a result of the proposed project development. Suitable topsoil material and growth media (Carlin material from alluvial deposits) in the proposed disturbance areas would be salvaged for subsequent use in reclamation. Expedited reclamation and improved success would be associated with the Proposed Action because the Bazza Waste Rock Facility would be reclaimed sooner. A permanent loss of soil productivity would occur on approximately 129 of the 1,180 acres in association with the expanded pit and perimeter buffer, which would not be reclaimed.

Vegetation Resources

The proposed project would remove or disturb approximately 1,180 acres of vegetation, the majority of which (approximately 1,051 acres) subsequently would be reclaimed. Project-related activities would result in the conversion of primarily shrub-dominated communities to grass/forb-dominated communities in the short term. Over the long term, shrubs would become re-established and increase in abundance within the majority of the disturbed areas as a result of reclamation and natural colonization. Reclamation would be completed on all mine disturbance areas except the 129 acres associated with the pit expansion. No wetland/riparian vegetation or special status plant species would be removed, disturbed, or affected as a result of the proposed project. Continuation of BGMI's weed control program in conjunction with the reclamation plan substantially would reduce the potential for noxious weed establishment in the proposed disturbance areas.

Aquatic Resources/Special Status Aquatic Species

No project-related disturbance would occur within perennial stream habitat. Surface disturbance would occur during haul road construction across an intermittent/ephemeral segment of one creek; however, this area does not provide fisheries habitat on a consistent basis. No impacts to special status aquatic species are anticipated as a result of the proposed project.

Wildlife Resources/Terrestrial Wildlife

Wildlife Habitat. Approximately 943 acres of native wildlife habitat would be disturbed as a result of the proposed project. Approximately 129 acres of terrestrial habitat associated with the pit expansion would not be reclaimed. Development of a post-mining pit lake, which is projected to be within Nevada wildlife propagation standards, potentially would result in an increase in habitat for waterfowl and aquatic species.

Big Game. Approximately 943 acres of low-density mule deer range consisting primarily of sagebrush shrubland habitat would be disturbed as a result of mine expansion-related activities. Approximately 101 acres of this disturbance would be associated with the pit expansion and would not be reclaimed. The construction of the proposed Clydesdale Waste Rock Facility would decrease the width of an important existing big game migration corridor located along Bell Creek and further fragment mule deer habitat. Direct impacts include the incremental long-term reduction of approximately 66 acres of summer range and 360 acres of crucial winter range for pronghorn.

Small Game. Direct impacts to small game species would include the temporary reduction of approximately 943 acres of potentially suitable habitat until vegetation is re-established, and the permanent loss of approximately 101 acres of potential habitat.

Impacts to Breeding Birds. Direct impacts to bird species as a result of the proposed project would include the temporary loss of approximately 943 acres and the permanent loss of approximately 101 acres of potentially suitable breeding, roosting, and foraging habitat. Potential direct impacts to breeding birds (i.e., loss of nests, eggs, or young) would be minimized through the clearing of vegetation outside of the breeding season, to the extent possible, and the implementation of breeding bird surveys and appropriate mitigation as needed in coordination with the BLM and Nevada Department of Wildlife.

Human Presence and Noise. Increased noise, traffic, and human presence associated with mine expansion and operation is expected to result in negligible to low impacts to wildlife species.

Potential for Hazardous Materials Spill Effects to Wildlife. The potential for impacts to wildlife in the event of a hazardous materials spill would be the same as the No Action Alternative, but extended for 4 additional years.

Potential Impacts to Wildlife Associated with Pit Lake Water Quality. An ecological risk assessment (ERA) was conducted to evaluate potential impacts to wildlife, livestock, and fish as a result of exposure to pit lake water. The ERA followed U.S. Environmental Protection Agency (USEPA) guidelines for conducting risk assessments as well as Nevada BLM ERA guidance. Predicted pit lake water metal constituents at Year 50 without the Rodeo Creek Diversion were used for the analysis because constituent of potential concern (COPC) concentrations are expected to be higher without Rodeo Creek water input. These higher, more conservative COPC concentrations were compared to Nevada water quality criteria, No Adverse Effect Level-based Hazard Quotients, and Low Adverse Effect Level-based Hazard Quotients to assess risk. The evaluation indicated that the predicted pit lake water quality would not pose unacceptable risks to wildlife, fish, or livestock.

Wildlife Resources/Special Status Wildlife Species

Bats. Direct impacts would include the long-term disturbance of foraging habitat, including approximately 867 acres of sagebrush shrubland habitat. Impacts also would result in the permanent loss of approximately 101 acres of sagebrush shrubland habitat from the development of the proposed facilities.

Preble's Shrew and Dark Kangaroo Mouse. Direct impacts would result in the long-term reduction of approximately 943 acres and permanent loss of approximately 101 acres of potentially suitable habitat for these species. This impact would be considered low, considering the large amount of suitable habitat located within the study area. Project construction likely would result in the direct mortality of individuals, if present. The loss of individuals would not result in population-level effects.

Pygmy Rabbit. Direct impacts would result in the long-term reduction of approximately 867 acres and permanent loss of approximately 101 acres of potentially suitable sagebrush habitat (big sagebrush-dominated habitats) for this species. This impact would be considered low to moderate, considering that potentially suitable habitat is located within the study area, but no rabbits have been documented in a recent study. Project construction likely would result in the direct mortality of individual rabbits, if present. The loss of individual pygmy rabbits would not result in population-level effects.

Bald Eagle. No bald eagle nest sites occur within the project boundary. Occurrence of this species would be limited to migrating and dispersing individuals. Impacts would include the long-term reduction of approximately 943 acres of potential foraging habitat until reclamation has been completed and vegetation has been re-established. The permanent loss of approximately 101 acres of potential foraging habitat associated with development of the proposed facilities would occur. Indirect impacts associated with mine-related noise and human presence currently occur at the site and would continue under the proposed project. Based on implementation of BGMI's committed environmental protection measures, the lack of existing nest sites within the project boundary, and the existing level of mining activity at the site, potential impacts to this species as a result of the Proposed Action would be considered low.

Swainson's Hawk and Ferruginous Hawk. No direct impacts to nesting Swainson's or ferruginous hawks would be anticipated from project construction due to the lack of breeding habitat within the project boundary. Direct impacts would include the long-term reduction of approximately 943 acres of potential foraging habitat; until reclamation has been completed and vegetation has been re-established. The permanent loss of approximately 101 acres of potential foraging habitat associated with development of the proposed facilities would occur. However, this impact would be considered negligible based on the overall availability of suitable foraging habitat in the vicinity of the study area. Indirect impacts would continue to result from mine-related noise and human presence. Based on implementation of BGMI's committed environmental protection

measures, the lack of existing nest sites within the project vicinity, and the existing level of mining activity, potential impacts to these species as a result of the Proposed Action would be considered low.

Golden Eagle. No golden eagle nest sites occur within the project boundary. In addition, no suitable nesting habitat (e.g., exposed rocky outcrops) occurs within the project boundary. Direct impacts would include the long-term reduction of approximately 943 acres of potential foraging habitat until reclamation has been completed and vegetation has been re-established. The permanent loss of approximately 101 acres of potential foraging habitat associated with development of the proposed facilities would occur. Indirect impacts associated with mine-related noise and human presence currently occur at the site and would continue under the proposed project. Based on implementation of BGMI's committed environmental protection measures, the lack of existing nest sites within the project boundary, and the existing level of mining activity, potential impacts to this species as a result of the Proposed Action would be considered low.

Prairie Falcon and Peregrine Falcon. No direct impacts to nesting falcons would be anticipated from project construction due to the lack of breeding habitat within the project boundary. Direct impacts to migrating and foraging falcons would include the long-term reduction of approximately 943 acres of potential foraging habitat until reclamation has been completed and vegetation has been re-established. The permanent loss of approximately 101 acres of habitat associated with development of the proposed facilities would occur. Indirect impacts would continue to result from mine-related noise and human presence. Based on the implementation of BGMI's committed environmental protection measures, the lack of existing nest sites within the project boundary, and the existing level of mining activity, potential impacts to these species as a result of the Proposed Action would be considered low.

Greater Sage-grouse. No impacts to breeding greater sage-grouse would be anticipated from project activities. Although greater sage-grouse could nest in upland habitats within the project boundary, it is anticipated that brooding activity would be low, due to the limited availability of surface water and riparian vegetation in the study area. Direct impacts to this species would include the long-term reduction of approximately 867 acres of sagebrush shrublands habitat and the permanent loss of approximately 101 acres of sagebrush shrublands habitat in association with the development of the proposed facilities. Indirect impacts would continue to result from mine-related noise and human presence. This impact would be considered negligible based on the overall availability of suitable habitat in the project vicinity.

Burrowing Owl. Although no burrowing owl nest sites have been documented within the project boundary, sagebrush shrubland and grassland vegetation that would be disturbed as a result of the Proposed Action would be suitable habitat for foraging birds within the study area. Direct impacts to this species would include the short-term reduction of approximately 943 acres of potential sagebrush shrubland breeding and foraging habitat until reclamation has been completed and vegetation has been re-established. The permanent loss of approximately 101 acres of habitat associated with development of the proposed facilities would occur. Indirect impacts would continue to result from mine-related noise and human presence. Based on implementation of BGMI's committed environmental protection measures and the existing level of mining activity, potential impacts to this species as a result of the Proposed Action would be considered low.

Long-eared and Short-eared Owls. Although no nests have been identified, suitable breeding habitat is present within the study area. Impacts to breeding birds as a result of proposed mine-related activities would be anticipated based on potentially suitable breeding habitat (e.g., open shrublands) in the proposed disturbance areas. Direct impacts to these species would result from the long-term reduction of approximately 943 acres of potential foraging habitat and the permanent loss of approximately 101 acres of potential foraging habitat in association with the development of the proposed facilities. These impacts would be considered negligible based on the overall availability of suitable habitat in the project vicinity. Indirect impacts would continue to result from mine-related noise and human presence. Based on the implementation of BGMI's committed environmental protection measures, the overall availability of suitable habitat in the project vicinity, and the existing level of mining, potential impacts to these species as a result of the Proposed Action would be considered low.

Loggerhead Shrike, Yellow-breasted Chat, and Vesper Sparrows. Based on the presence of potentially suitable breeding habitat, direct impacts to breeding pairs as a result of proposed mine-related activities could include abandonment of a breeding territory or nest site or the potential loss of eggs or young, which would reduce productivity for that breeding season. Direct impacts to this species would include the long-term reduction of approximately 943 acres of potential breeding and foraging habitat until reclamation has been completed and vegetation has re-established. The permanent loss of approximately 101 acres of breeding and foraging habitat in association with the development of the proposed facilities would occur. Indirect impacts would continue to result from mine-related noise and human presence. These impacts would be considered negligible based on implementation of BGMI's committed environmental protection measures, the overall availability of suitable habitat in the project vicinity, and the existing level of mining activity at the site.

Cultural Resources

Five known historic properties (i.e., those properties eligible for, or listed on, the National Register of Historic Places [NRHP]) are located in the area of potential effect. Adverse effects to the five NRHP-eligible sites were mitigated in accordance with the treatment plan and Programmatic Agreement (PA). The PA is an agreement among the BLM Elko District Office, Nevada State Historic Preservation Officer (SHPO), Advisory Council on Historic Preservation, and BGMI that defines the measures to be undertaken to ensure that BLM's objectives and responsibilities regarding the protection of historic properties are fulfilled. Although data recovery was completed at the five historic properties and Section 106 of National Historic Preservation Act provides for findings of no adverse effect through mitigation, some data about the site and the site itself are lost. Direct effects to NRHP-eligible properties, including surface or subsurface disturbance during project construction or operations, could occur. The historic properties treatment plan specifies BLM- and SHPO-approved mitigation procedures for each NRHP-eligible property potentially affected by the proposed project. Based on the PA and the results of consultation and implementation of the treatment plan, the proposed project is not anticipated to have adverse effects on historic properties.

Native American Traditional Values

Native American consultation regarding potential effects and possible mitigation are ongoing between the BLM Elko District Office and tribal representatives. If a traditional cultural property (TCP) or place of cultural or religious importance is identified by tribal representatives, no surface disturbance would occur within or immediately adjacent to the boundary of the property prior to completion of all consultation required by law. If data recovery or other form of mitigation is required at a TCP or place of cultural or religious importance, a data recovery or mitigation plan would be reviewed and approved by the BLM and SHPO. Tribal representatives would be asked to participate in the development of any such data recovery or mitigation plan. Therefore, no adverse effects to Native American traditional values are anticipated as a result of the proposed project.

Air Quality

Based on air quality dispersion modeling results for the existing Goldstrike Mine operations, the maximum concentrations of particulate matter with an aerodynamic diameter of 10 microns or less, nitrogen dioxide, carbon monoxide, and sulfur dioxide would not exceed Nevada or National Ambient Air Quality Standards for the proposed project. The proposed project would continue to operate at current levels of production, design capacity, or emission limits, and therefore is not anticipated to increase emission rates over current levels. There would be no impacts to Prevention of Significant Deterioration Class I areas as a result of the proposed project.

Particulate mercury is naturally present in the soils, waste rock, and ore at the mine; therefore, it would be present as a small fraction of all particulate emissions produced during the various mine processes. Material handling, crushing, conveying, and stacking are potential emission sources of particulate mercury. Controls would be applied to each of the processes to reduce overall particulate emissions. The estimated total airborne process emissions of mercury from the proposed project would be approximately 625 pounds over 5 years of roaster operation based on the 12.44 million tons of ore to be processed and current emission controls. The

USEPA Regional Modeling System for Aerosols and Deposition (REMSAD) model was used to predict the relative contribution of mercury deposition from the Goldstrike Mine compared to other local, regional, and global sources to watersheds located in Nevada. Modeling results indicated that the Goldstrike Mine contributes from 0.01 to 2.47 percent of the mercury deposition to watersheds bordering Nevada, Idaho, and Utah. Annual deposition rates of mercury from Goldstrike operations ranged from approximately 2.25 grams per square kilometer per year (g/km^2-yr) near the source to <0.1 g/km^2-yr at a distance of 30 to 100 kilometers from the source based on REMSAD model isopleth output. The statewide average global background deposition of mercury is approximately 11.1 g/km^2-yr. Based on mercury assay data from drill core samples taken from the proposed layback areas, annual mercury emissions under the Proposed Action would be similar to, or less than, current emissions. It is anticipated that BGMI's installation of Nevada maximum achievable control technology would further minimize mercury emissions associated with the Proposed Action.

The combined hazardous air pollutant (HAP) emissions would be less than the major source limit of 25 tons per year; therefore, the Proposed Action would not constitute a major HAP source.

Social and Economic Values

The Proposed Action would continue to employ the current mine workforce of approximately 1,600 workers for 4 additional years (through 2015) beyond the currently permitted operation. There would be no increase in permanent workforce, thus no additional population growth as a result of the proposed project. There may be an increase in temporary contract workers to perform prestripping operations, but this work would be of relatively short duration. Annual tax revenues anticipated for the proposed project are expected to be approximately $11.4 million from net proceeds taxes, $21.6 million from sales and use taxes, $0.6 million from business activity taxes, and $3.4 million from *ad valorem* property taxes for the State and Eureka and Elko counties based on the 2004-2006 data. These levels are likely to continue for the additional years of mine life. Housing, public facilities and services, and schools in the study area are adequate since there would be no increase in employment as a result of the Proposed Action. The public revenue generated by the Proposed Action is expected to be a direct benefit to the communities because there would be no major public service shortfalls. The social and economic effects of the Proposed Action would be beneficial to study area communities.

Visual Resources

The Proposed Action would result in an expansion of the existing BGMI mining and processing operations in Boulder Valley. The most visible proposed features would include the new Clydesdale Waste Rock Facility, the new Goldstrike No. 3 Tailings Facility, and expansion of the Betze Pit to the northwest. After completion of reclamation activities, visual effects of the waste rock facilities would be reduced due to BGMI's commitment to vary their topography to mimic natural landforms to the degree possible. The tailings facility reclamation also would use native vegetation to blend in with the surrounding area. The long-term visual impact in Visual Resource Management Class IV areas would be low.

Hazardous Materials and Solid Waste

The proposed project would require the continued transport, handling, storage, use, and disposal of materials classified as hazardous under various regulatory frameworks for an additional 4 years. All hazardous materials would continue to be shipped to and from the site in accordance with applicable U.S. Department of Transportation (USDOT) hazardous materials regulations. All shipping containers and vehicles would continue to be USDOT-approved for the specific materials. Historical incident analysis indicates that there would be a low probability of an accident involving the release of hazardous materials or fuel releases during the life of the Proposed Action.

Storage, containment, transportation, handling of hazardous waste, and all operations would be in accordance with BGMI's existing Environmental Incident Response Manual and Spill Prevention, Control and Countermeasures Plan, which would ensure that impacts from potential spills would be minimized and the spilled materials contained and removed. All hazardous waste generated at the mine would be disposed of in

accordance with applicable federal and state regulations. Non-hazardous solid waste would be disposed of in a Class III waivered landfill or in the existing on site landfills. All hazardous substances would be handled in accordance with applicable Mine Safety and Health Administration or Occupational Safety and Health Administration regulations (Titles 30 and 29 of the Code of Federal Regulations [CFR]).

BLM-preferred Alternative

The Council on Environmental Quality Regulations (40 CFR 1502.14e) direct that an EIS "identify the agency's preferred alternative or alternatives, if one or more exists, in the draft statement and identify such alternative in the final statement unless another law prohibits the expression of such a preference." The BLM has selected a preferred alternative based on the analysis in this SEIS. This preferred alternative is the alternative that best fulfills the agency's statutory mission and responsibilities, considering economic, environmental, technical, and other factors. The BLM has determined that the preferred alternative is the Proposed Action as outlined in Chapter 2.0 with mitigation measures specified in Chapter 3.0 of this SEIS.

Contents

Executive Summary **ES-1**

1.0 Introduction **1-1**

1.1 Purpose and Need for Action 1-1

1.2 Relationship to BLM and Non-BLM Policies, Plans, and Programs 1-4

1.2.1 Federal Land Use Plan Conformance 1-4

1.2.2 State and Local Land Use Plans and Policies 1-4

1.3 Authorizing Actions 1-5

1.4 SEIS Organization 1-6

1.5 Summary of Major Issues 1-6

2.0 Description of Alternatives Including the Proposed Action **2-1**

2.1 Introduction and Background Action 2-1

2.1.1 Current Mining Disturbance 2-2

2.2 No Action Alternative 2-2

2.2.1 Current Mining Operations or Facilities that will Continue Unchanged 2-4

2.2.2 Operations that may be Affected by the Proposed Action 2-16

2.2.3 Existing Mine Reclamation and Site Closure Plans 2-18

2.3 Proposed Action 2-29

2.3.1 Overview 2-29

2.3.2 Use and Occupancy of Public Lands 2-30

2.3.3 Land Ownership and Mining Claims 2-30

2.3.4 Schedule and Work Force 2-30

2.3.5 Expansion of Mining Operations 2-32

2.3.6 Applicant-committed Environmental Protection Measures 2-43

2.3.7 Reclamation and Site Closure Plans 2-48

2.4 Bazza Waste Rock Facility Alternative (No Clydesdale) 2-56

2.5 Alternatives Considered but Eliminated from Detailed Analysis 2-58

2.5.1 Modified Clydesdale Waste Rock Facility Alternative 2-58

2.5.2 Offsite Waste Rock Facility 2-58

2.5.3 Underground Mining Alternative 2-61

2.5.4 Reduced Tailings Facility Alternative 2-61

2.6 Comparative Analysis of Alternatives 2-61

2.7 BLM-preferred Alternative 2-61

3.0 Affected Environment and Environmental Consequences 3.0-1

Introduction 3.0-1

General Setting 3.0-2

3.1 Past, Present, and Reasonably Foreseeable Future Actions 3.1-1
- 3.1.1 Past and Present Actions 3.1-2
- 3.1.2 Reasonably Foreseeable Future Actions 3.1-7

3.2 Geology and Minerals 3.2-1
- 3.2.1 Affected Environment 3.2-1
- 3.2.2 Environmental Consequences 3.2-5
- 3.2.3 Cumulative Impacts 3.2-8
- 3.2.4 Mitigation Measures and Monitoring 3.2-9
- 3.2.5 Residual Impacts 3.2-9

3.3 Groundwater Resources and Geochemistry 3.3-1
- 3.3.1 Affected Environment 3.3-1
- 3.3.2 Environmental Consequences 3.3-22
- 3.3.3 Cumulative Groundwater Effects 3.3-62
- 3.3.4 Mitigation Measures and Monitoring 3.3-64
- 3.3.5 Residual Impacts 3.3-65

3.4 Surface Water Resources 3.4-1
- 3.4.1 Affected Environment 3.4-1
- 3.4.2 Environmental Consequences 3.4-6
- 3.4.3 Cumulative Impacts 3.4-12
- 3.4.4 Mitigation Measures and Monitoring 3.4-14
- 3.4.5 Residual Impacts 3.4-14

3.5 Soils and Reclamation 3.5-1
- 3.5.1 Affected Environment 3.5-1
- 3.5.2 Environmental Consequences 3.5-12
- 3.5.3 Cumulative Impacts 3.5-20
- 3.5.4 Mitigation Measures and Monitoring 3.5-21
- 3.5.5 Residual Impacts 3.5-22

3.6 Aquatic Resources 3.6-1
- 3.6.1 Affected Environment 3.6-1
- 3.6.2 Environmental Consequences 3.6-6
- 3.6.3 Cumulative Impacts 3.6-9
- 3.6.4 Mitigation Measures and Monitoring 3.6-9
- 3.6.5 Residual Impacts 3.6-10

3.7 Vegetation Resources 3.7-1
- 3.7.1 Affected Environment 3.7-1
- 3.7.2 Environmental Consequences 3.7-9
- 3.7.3 Cumulative Impacts 3.7-13
- 3.7.4 Mitigation Measures and Monitoring 3.7-16
- 3.7.5 Residual Impacts 3.7-17

3.8 Wildlife Resources 3.8-1
3.8.1 Affected Environment 3.8-1
3.8.2 Environmental Consequences 3.8-14
3.8.3 Cumulative Impacts 3.8-29
3.8.4 Mitigation Measures and Monitoring 3.8-36
3.8.5 Residual Impacts 3.8-36
3.9 Cultural Resources 3.9-1
3.9.1 Affected Environment 3.9-1
3.9.2 Environmental Consequences 3.9-4
3.9.3 Cumulative Impacts 3.9-6
3.9.4 Mitigation Measures and Monitoring 3.9-7
3.9.5 Residual Impacts 3.9-7
3.10 Native American Traditional Values 3.10-1
3.10.1 Affected Environment 3.10-1
3.10.2 Environmental Consequences 3.10-4
3.10.3 Cumulative Impacts 3.10-4
3.10.4 Residual Impacts 3.10-6
3.11 Air Quality 3.11-1
3.11.1 Affected Environment 3.11-1
3.11.2 Environmental Consequences 3.11-7
3.11.3 Cumulative Impacts 3.11-14
3.11.4 Residual Impacts 3.11-22
3.12 Social and Economic Values 3.12-1
3.12.1 Affected Environment 3.12-1
3.12.2 Environmental Consequences 3.12-10
3.12.4 Mitigation Measures and Monitoring 3.12-15
3.12.5 Residual Impacts 3.12-15
3.13 Visual Resources 3.13-1
3.13.1 Affected Environment 3.13-3
3.13.2 Environmental Consequences 3.13-4
3.13.3 Cumulative Impacts 3.13-7
3.13.4 Mitigation Measures and Monitoring 3.13-7
3.13.5 Residual Impacts 3.13-8
3.14 Hazardous Materials and Solid Waste 3.14-1
3.14.1 Affected Environment 3.14-1
3.14.2 Environmental Consequences 3.14-4
3.14.3 Cumulative Impacts 3.14-8
3.14.4 Mitigation Measures and Monitoring 3.14-8
3.14.5 Residual Impacts 3.14-8
3.15 Energy Requirements 3.15-1
3.16 Relationship between Short-term Uses of the Human Environment and the Maintenance and Enhancement of Long-term Productivity 3.16-1
3.17 Irreversible and Irretrievable Commitment of Resources 3.17-1

4.0 Public Consultation and Coordination 4-1
4.1 Public Participation 4-1
4.1.1 Scoping 4-1
4.1.2 Public Review of the Draft SEIS 4-1
4.2 Consultation and Coordination with Federal, State and Local Agencies, and Tribes 4-1
4.3 SEIS Distribution List 4-3

5.0 List of Preparers and Reviewers 5-1
5.1 Bureau of Land Management EIS Team 5-1
5.2 ENSR EIS Team (Third-party Consultant) 5-2
5.3 Barrick Goldstrike Mine Reviewers 5-3

6.0 References, Acronyms and Abbreviations, Glossary, and Index 6-1
6.1 References 6-1
6.2 Acronyms and Abbreviations 6-17
6.3 Glossary 6-24
6.4 Index 6-31

List of Appendices

Appendix A - Current Goldstrike Mine Permits and Authorizations

Appendix B - Groundwater Resources and Geochemistry

Appendix C - Groundwater Supplemental Information

Appendix D - Cultural Resources Inventories

Appendix E - Special Status Species

List of Tables

Table 1-1	Major Permits and Approvals	1-5
Table 2-1	Currently Authorized Goldstrike Mine Disturbance	2-3
Table 2-2	Life of Mine Water Budget Summary Table for BGMI (annualized gpm) (No Action Alternative)	2-9
Table 2-3	Goldstrike Mine Estimated Ore and Waste Rock Annual Totals (in tons) Under the No Action Alternative	2-19
Table 2-4	Interim Reclamation Seed Mix	2-25
Table 2-5	Reclamation Seed Mix	2-26
Table 2-6	Authorized and Proposed Disturbance for the Proposed Action	2-29
Table 2-7	Legal Description of Proposed Action	2-30
Table 2-8	Waste Rock, Carlin Material, and Ore Tonnages (millions of tons) to be Mined Under the Proposed Action	2-33
Table 2-9	Goldstrike Mine Estimated Ore and Waste Rock Annual Totals that Include the Proposed Action	2-34
Table 2-10	List of Expected Mine Mobile Equipment	2-35
Table 2-11	Proposed Staged Construction of Goldstrike No. 3 Tailings Facility	2-40
Table 2-12	Impact Summary and Comparison of the Proposed Action, Bazza Waste Rock Facility Alternative, and No Action Alternative	2-63
Table 3.1-1	Mining-related Surface Disturbance Associated with Past and Present Actions and RFFAs	3.1-1
Table 3.3-1	Major Subregions Within the Hydrologic Study Area	3.3-1
Table 3.3-2	Summary of Hydrostratigraphic Unit Hydraulic Properties	3.3-2
Table 3.3-3a	Pre-mining Simulated Water Balance (acre-feet)	3.3-10
Table 3.3-3b	Current Simulated Water Balance July 2005 – June 2006 (acre-feet)	3.3-11
Table 3.3-4	Lithology, Static ABA, and Column Test Data – 1997 Column Samples	3.3-16
Table 3.3-5	2002 Column Test Charge Samples	3.3-17
Table 3.3-6	BGMI Humidity Cell Test Summary with BGMI and BLM Waste Rock Classifications	3.3-18
Table 3.3-7	Predicted Betze Pit Lake Chemistry in Year 50 under the Current Mine Plan	3.3-38
Table 3.3-8	Predicted Betze Pit Lake Chemistry in Year 400 Under the Current Mine Plan	3.3-39
Table 3.3-9	Predicted Betze Pit Lake Chemistry in Year 50, Expanded Pit	3.3-55
Table 3.3-10	Predicted Betze Pit Lake Chemistry in Year 400, Expanded Pit	3.3-56
Table 3.3-11	Predicted Betze Pit Lake Chemistry During Early Stage Filling (Years 5 to 13) without Limestone Addition	3.3-58
Table 3.3-12	Predicted Betze Pit Lake Chemistry During Early Stage Filling (Years 5 to 13) with Limestone Addition	3.3-59
Table 3.4-1	Average Monthly Precipitation (in inches) at Elko and Battle Mountain, 1950 - 2006	3.4-1

Table 3.5-1 Physical and Chemical Characteristics and Reclamation Suitabilities of Soil Map Units Occurring within the Proposed Project Boundary 3.5-4

Table 3.6-1 Fish Species in Maggie Creek Subbasin 3.6-4

Table 3.7-1 Vegetation Cover Types within the Study Area 3.7-1

Table 3.7-2 Designated Noxious Weed Species Potentially Occurring within the Study Area 3.7-7

Table 3.8-1 Human West Nile Cases in Elko County, Eureka County, and Nevada, 2005 to 2007 ..... 3.8-28

Table 3.8-2 Wildlife, Mule Deer, Pronghorn, and Greater Sage-grouse Habitat Disturbance 3.8-34

Table 3.10-1 Summary of Native American Consultation 3.10-3

Table 3.11-1 Monthly Climate Summary Elko WB Airport, Nevada 3.11-3

Table 3.11-2 Goldstrike Mine North Block Meteorology Station Data 3.11-5

Table 3.11-3 National and State of Nevada Ambient Air Quality Standards 3.11-6

Table 3.11-4 Reported Annual Mercury Emissions for the Goldstrike Mine from the TRI and Nevada Mercury Control Program 3.11-10

Table 3.11-5 Goldstrike Mine 2006 Reported Mercury Emissions and Speciation Estimates 3.11-10

Table 3.11-6 Mercury Controls on Thermal Processes at the Goldstrike Mine 3.11-11

Table 3.11-7 HAP Emissions for the Goldstrike Mine 3.11-13

Table 3.11-8 Summary of Emission Sources Included in Leeville Air Quality Modeling 3.11-14

Table 3.11-9 Cumulative Mercury Monitoring Data 3.11-15

Table 3.11-10 State-Wide Global Background Deposition 3.11-17

Table 3.11-11 Mercury Deposition on Border Watersheds 3.11-17

Table 3.12-1 Population Characteristics 3.12-3

Table 3.12-2 Nonagricultural Wage and Salary Employment by Sector 3.12-4

Table 3.12-3 County and City Budgets for Fiscal Year 2006-2007 ..... 3.12-8

Table 3.14-1 Goldstrike Mine Hazardous Waste Generated in 2005 ..... 3.14-4

Table 3.14-2 Large Spills Recorded from June 2002 to July 2003 at the Goldstrike Mine 3.14-6

Table 3.15-1 BGMI Estimated Fuel and Electrical Power Consumption 3.15-2

Table 3.17-1 Irreversible and Irretrievable Commitment of Resources by the Proposed Action 3.17-2

Table 4-1 Scoping Comments Distribution 4-2

List of Figures

Figure 1-1 General Location Map 1-2
Figure 1-2 Site Map of Surface Ownership 1-3
Figure 2-1 Detail of Existing Goldstrike Mine Facilities 2-5
Figure 2-2 Betze Pit Dewatering Rates and Groundwater Level Elevations from Monitoring Wells 2-10
Figure 2-3 Water Management Facilities 2-12
Figure 2-4 Rodeo Creek Diversions 2-14
Figure 2-5 Vegetative Cover at Treatment Area H6 with Carlin Material on the AA Leach Pad in 2007 2-22
Figure 2-6 Vegetative Cover at Treatment Area H7 with Carlin Material on the AA Leach Pad in 2007 2-22
Figure 2-7 Vegetative Cover at Treatment Area AR3 with Topsoil on the Bazza Waste Rock Facility Pad in 2007 2-23
Figure 2-8 Vegetative Cover at Treatment Area AS with Carlin Material on the Bazza Waste Rock Facility in 2004 2-23
Figure 2-9 No Action Alternative Post-mining Reclamation Topography 2-24
Figure 2-10 Noxious Weed Treatment Areas on Barrick Goldstrike Mine Site 2-27
Figure 2-11 Proposed Action Facilities 2-31
Figure 2-12 Clydesdale Cross-section and Profile 2-37
Figure 2-13 Betze Pit Backfill Areas 2-38
Figure 2-14 Goldstrike No. 3 Tailings Facility Profile 2-41
Figure 2-15 Reclamation Chronology: Clydesdale and Bazza Waste Rock Facilities 2-46
Figure 2-16 Proposed Action Post-mining Reclamation Topography 2-49
Figure 2-17 Proposed Action Conceptual Reclamation Schedule 2-52
Figure 2-18 Mule Deer Observed on the AA Leach Pad, February 2008 2-53
Figure 2-19 Mule Deer Observed on the AA Leach Pad, February 2008 2-53
Figure 2-20 Goldstrike No. 3 Tailings Draindown Curve Comparison for Thickened Tailings 2-55
Figure 2-21 Bazza Waste Rock Facility Alternative Post-mining Topography 2-57
Figure 2-22 Bazza Waste Rock Facility Alternative Cross-section and Profile 2-59
Figure 2-23 Bazza Waste Rock Facility Alternative Reclamation Schedule 2-60
Figure 3.0-1 General Setting 3.0-3
Figure 3.1-1 Past, Present, and Reasonably Foreseeable Future Mining Activities – Carlin Trend in Nevada 3.1-3
Figure 3.1-2 Mine Disturbance – Carlin Trend in Nevada 3.1-4
Figure 3.2-1 Geology of the Area 3.2-3
Figure 3.2-2 Geologic Resources Cumulative Effects Study Area 3.2-4

Figure 3.2-3 Major Hydrostructural Features 3.2-6
Figure 3.3-1 Water Resources Cumulative Effects Study Area 3.3-3
Figure 3.3-2 Groundwater Elevation Fourth Quarter 2006 and First Quarter 2007 ..... 3.3-8
Figure 3.3-3 Changes in Groundwater Elevation Fourth Quarter 2006 and First Quarter 2007 ..... 3.3-9
Figure 3.3-4 Structure of Betze Pit Lake Model 3.3-24
Figure 3.3-5 Comparison of Betze Pit Lake Water Elevation for the Current Mine Plan with and without Diversion of Rodeo Creek 3.3-25
Figure 3.3-6 Rate of Inflow or Outflow for Various Hydrologic Components of the Current Mine Plan Pit Lake with Rodeo Creek Diversion 3.3-26
Figure 3.3-7 Betze Pit Lake pH, Current Mine Plan 3.3-28
Figure 3.3-8 Betze Pit Lake Total Dissolved Solids, Current Mine Plan 3.3-28
Figure 3.3-9 Betze Pit Lake Calcium Chemistry, Current Mine Plan 3.3-29
Figure 3.3-10 Betze Pit Lake Magnesium Chemistry, Current Mine Plan 3.3-29
Figure 3.3-11 Betze Pit Lake Sodium Chemistry, Current Mine Plan 3.3-30
Figure 3.3-12 Betze Pit Lake Sulfate Chemistry, Current Mine Plan 3.3-30
Figure 3.3-13 Betze Pit Lake Bicarbonate Chemistry, Current Mine Plan 3.3-31
Figure 3.3-14 Betze Pit Lake Chloride Chemistry, Current Mine Plan 3.3-31
Figure 3.3-15 Betze Pit Lake Fluoride Chemistry, Current Mine Plan 3.3-32
Figure 3.3-16 Betze Pit Lake Quantity of Mineral Solids for Expanded Pit and Current Mine Plan 3.3-32
Figure 3.3-17 Betze Pit Lake Arsenic Chemistry, Current Mine Plan 3.3-33
Figure 3.3-18 Betze Pit Lake Iron Chemistry, Current Mine Plan 3.3-33
Figure 3.3-19 Betze Pit Lake Antimony Chemistry, Current Mine Plan 3.3-34
Figure 3.3-20 Betze Pit Lake Barium Chemistry, Current Mine Plan 3.3-34
Figure 3.3-21 Betze Pit Lake Cadmium Chemistry, Current Mine Plan 3.3-35
Figure 3.3-22 Betze Pit Lake Copper Chemistry, Current Mine Plan 3.3-35
Figure 3.3-23 Betze Pit Lake Manganese Chemistry, Current Mine Plan 3.3-36
Figure 3.3-24 Betze Pit Lake Nickel Chemistry, Current Mine Plan 3.3-36
Figure 3.3-25 Betze Pit Lake Zinc Chemistry, Current Mine Plan 3.3-37
Figure 3.3-26 Areas of Perennial Stream Reaches, Seeps, and Springs in the Hydrologic Study Area and Comparison of 2000 Maximum 10-foot Drawdown Extent 3.3-42
Figure 3.3-27 Comparison of 2007 10-foot Drawdown Contour (BGMI Pumping Only) and 2000 Cumulative Pumping 10-foot Drawdown Contour 3.3-43
Figure 3.3-28 Maximum Extent of 10-foot Drawdown Contours (BGMI Pumping Only) Pumping Case 2011 vs. 2015 ..... 3.3-44
Figure 3.3-29 Comparison of Betze Pit Lake Water Level for the Expanded Pit with and without Diversion of Rodeo Creek 3.3-45
Figure 3.3-30 Betze Pit Lake pH, Expanded Pit without the Addition of Limestone in the Early Years 3.3-46

Figure 3.3-31 Betze Pit Lake Total Dissolved Solids, Expanded Pit without the Addition of Limestone in the Early Years 3.3-46
Figure 3.3-32 Betze Pit Lake Calcium Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-47
Figure 3.3-33 Betze Pit Lake Magnesium Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-47
Figure 3.3-34 Betze Pit Lake Sodium Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-48
Figure 3.3-35 Betze Pit Lake Sulfate Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-48
Figure 3.3-36 Betze Pit Lake Bicarbonate Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-49
Figure 3.3-37 Betze Pit Lake Chloride Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-49
Figure 3.3-38 Betze Pit Lake Fluoride Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-50
Figure 3.3-39 Betze Pit Lake Arsenic Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-50
Figure 3.3-40 Betze Pit Lake Iron Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-51
Figure 3.3-41 Betze Pit Lake Antimony Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-51
Figure 3.3-42 Betze Pit Lake Barium Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-52
Figure 3.3-43 Betze Pit Lake Cadmium Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-52
Figure 3.3-44 Betze Pit Lake Copper Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-53
Figure 3.3-45 Betze Pit Lake Manganese Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-53
Figure 3.3-46 Betze Pit Lake Nickel Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-54
Figure 3.3-47 Betze Pit Lake Zinc Chemistry, Expanded Pit without the Addition of Limestone in the Early Years 3.3-54
Figure 3.3-48 Potentially Impacted Springs within the Cumulative Drawdown Area 3.3-63
Figure 3.4-1 Variation in Annual Precipitation at Elko and Battle Mountain 3.4-2
Figure 3.4-2 Current Surface Water Monitoring Locations in the Cumulative Effects Study Area 3.4-5
Figure 3.5-1 Soil Resources Cumulative Effects Study Area 3.5-2
Figure 3.5-2 Soil Types within the Proposed Project Boundary 3.5-3
Figure 3.5-3 Topsoil Storage Suitability within the Project Boundary 3.5-11
Figure 3.5-4 Carlin Material Vegetative Cover on AA Pad in 2006 Leach Pad at Treatment Area H6 with 3:1 Slope and West Aspect (Cedar Creek Associates 2007a) 3.5-13

Figure 3.5-5 Irretrievable Impacts to Soil Resources 3.5-18
Figure 3.6-1 Current Distribution of Lahontan Cutthroat Trout, Spotted Frogs, and Springsnails Occurrence 3.6-3
Figure 3.6-2 Predicted Maximum Drawdown (at 100 years post-mining) Direct Impacts in Relation to Lahontan Cutthroat Trout, Spotted Frogs, and Springsnails Occurrence 3.6-8
Figure 3.6-3 Predicted Maximum Extent of 10-foot Cumulative Drawdown in Relation to Lahontan Cutthroat Trout, Spotted Frogs, and Springsnails Occurrence 3.6-11
Figure 3.7-1 Vegetation Cover Types Within the Study Area 3.7-3
Figure 3.7-2 Vegetation Cumulative Effects Study Area 3.7-4
Figure 3.7-3 Historical Fires - 1999 through July 2007 Cumulative Effects Study Area 3.7-15
Figure 3.8-1 Pronghorn Habitat 3.8-3
Figure 3.8-2 Mule Deer Migration Corridors 3.8-4
Figure 3.8-3 Greater Sage-grouse Historical Habitat 3.8-12
Figure 3.8-4 Wildlife Cumulative Effects Study Area 3.8-30
Figure 3.8-5 Mule Deer Cumulative Effects Study Area 3.8-31
Figure 3.8-6 Pronghorn Cumulative Effects Study Area 3.8-32
Figure 3.8-7 Greater Sage-grouse Cumulative Effects Study Area 3.8-33
Figure 3.9-1 Native American Traditional Values and Cultural Resources Cumulative Effects Study Area 3.9-3
Figure 3.11-1 Air Quality Cumulative Effects Study Area 3.11-2
Figure 3.11-2 Elko Wind Rose Diagram 3.11-4
Figure 3.11-3 Goldstrike Mine's Mercury Deposition Contributions as a Percent of Total 3.11-19
Figure 3.11-4 Global Background Mercury Deposition Contributions as a Percent of Total 3.11-20
Figure 3.11-5 Mercury Deposition in the Goldstrike Mine Area 3.11-21
Figure 3.12-1 Social and Economic Values CESA 3.12-2
Figure 3.13-1 Visual Resources Cumulative Effects Study Area 3.13-2
Figure 3.13-2 Key Observation Points for Visual Resources 3.13-5
Figure 3.14-1 Hazardous Materials Study Area 3.14-3

INTRODUCTION

CHAPTER 1

1.0 Introduction

Barrick Goldstrike Mines Inc. (BGMI) proposes to construct and operate the Betze Pit Expansion Project, which would include development of new facilities and expansion of existing open-pit gold mining operations at the Goldstrike Mine. The Goldstrike Mine is located in north-central Nevada approximately 25 miles northwest of Carlin in Eureka and Elko counties (**Figure 1-1**). BGMI, a wholly owned subsidiary of Barrick Gold Corporation, submitted an Amendment to the Plan of Operations (POO) (NVN-70708) and Reclamation Permit (0026) for the proposed Betze Pit Expansion Project on January 7, 2007, to the Bureau of Land Management (BLM) Elko District Office in compliance with 43 Code of Federal Regulations (CFR) 3809. A revised POO was submitted in June 2007. The proposed project would result in expansion of the Betze Pit, construction of the Clydesdale Waste Rock Facility and haul road, construction of the Goldstrike No. 3 Tailings Facility, and extension of employment at the Goldstrike Mine for an additional 4 years. The proposed project would utilize some of the existing primary facilities, including ore processing facilities and ancillary support facilities. If approved, the anticipated mine life would be extended approximately 4 years through 2015, followed by an estimated 15 years for ongoing ore processing and an additional 4 years for site closure and reclamation. To the extent possible, reclamation would occur concurrently with mine operations. Site closure and final reclamation would occur approximately 3 to 5 years beyond the end of ore processing.

The proposed Betze Pit Expansion Project would be located within Township 36 North (T36N), Range 49 East (R49E) and T36N, R50E in Eureka and Elko counties. The majority of the proposed 1,477 acres of surface disturbance would be located on private lands owned by BGMI. A total of 510 acres of public land administered by the BLM Elko District Office would be disturbed. Surface ownership in the project area is presented in **Figure 1-2**. The 1,477 acres of surface disturbance includes 297 acres of previously authorized disturbance for a total of 1,180 acres of new disturbance.

The proposed mining activities would be located on public and private lands. Although BLM approval is required only for the public lands involved pursuant to the Federal Land Policy and Management Act of 1976 (FLPMA), as amended, and the BLM's surface management regulations (43 CFR Subpart 3809), BLM is required by the National Environmental Policy Act of 1969 (NEPA) to review the impacts of the overall proposal including impacts on both public and private lands. The BLM has determined that a Supplemental Environmental Impact Statement (SEIS) must be prepared to fulfill NEPA requirements.

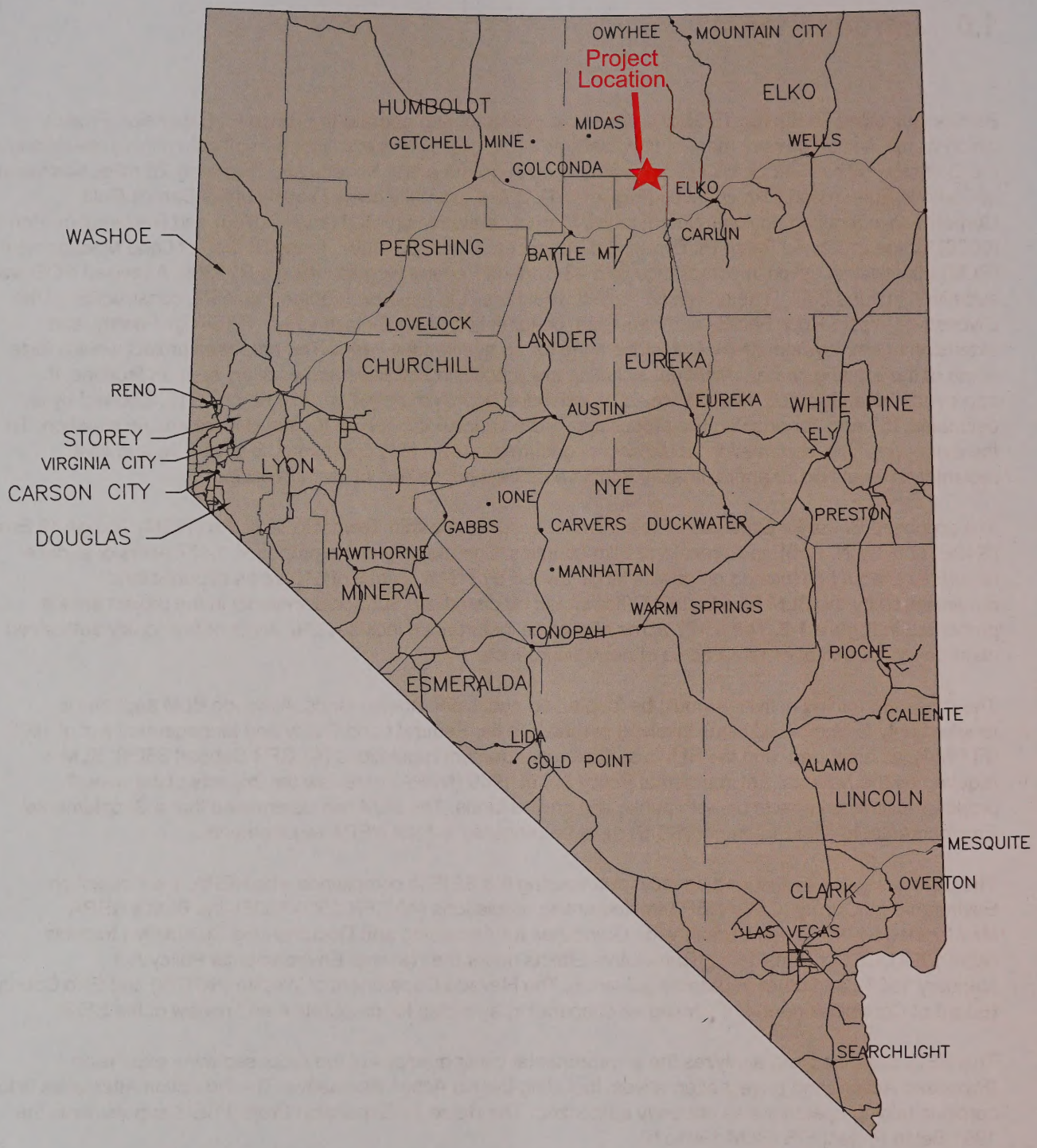
The BLM is serving as the lead agency for preparing the SEIS in compliance with NEPA, the Council on Environmental Quality (CEQ) NEPA implementing regulations (40 CFR 1500-1508), the BLM's NEPA Handbook (H-1790-1), the Bureau-wide Guidelines for Assessing and Documenting Cumulative Impacts (April 1994), CEQ's Considering Cumulative Effects under the National Environmental Policy Act (January 1997), and other applicable guidance. The Nevada Department of Wildlife (NDOW) and Elko County (Board of Commissioners) are serving as cooperating agencies for preparation and review of the SEIS.

This SEIS describes and analyzes the environmental consequences of the proposed mine expansion (Proposed Action) and project alternatives, including the No Action Alternative. The No Action Alternative is to continue mining operations as currently authorized. The Betze Pit Expansion Project SEIS supplements the 1991 Betze Project EIS (BLM 1991a,b).

1.1 Purpose and Need for Action

The purpose of the proposed Betze Pit Expansion Project is to continue to profitably recover gold reserves and resources from the project area utilizing, to the extent practical, existing facilities at BGMI's currently permitted operations.

The project need is to meet the prevailing market demand for gold. The prevailing market demand is adjusted on a daily basis on commodity exchanges throughout the world. This adjustment results from buyers and



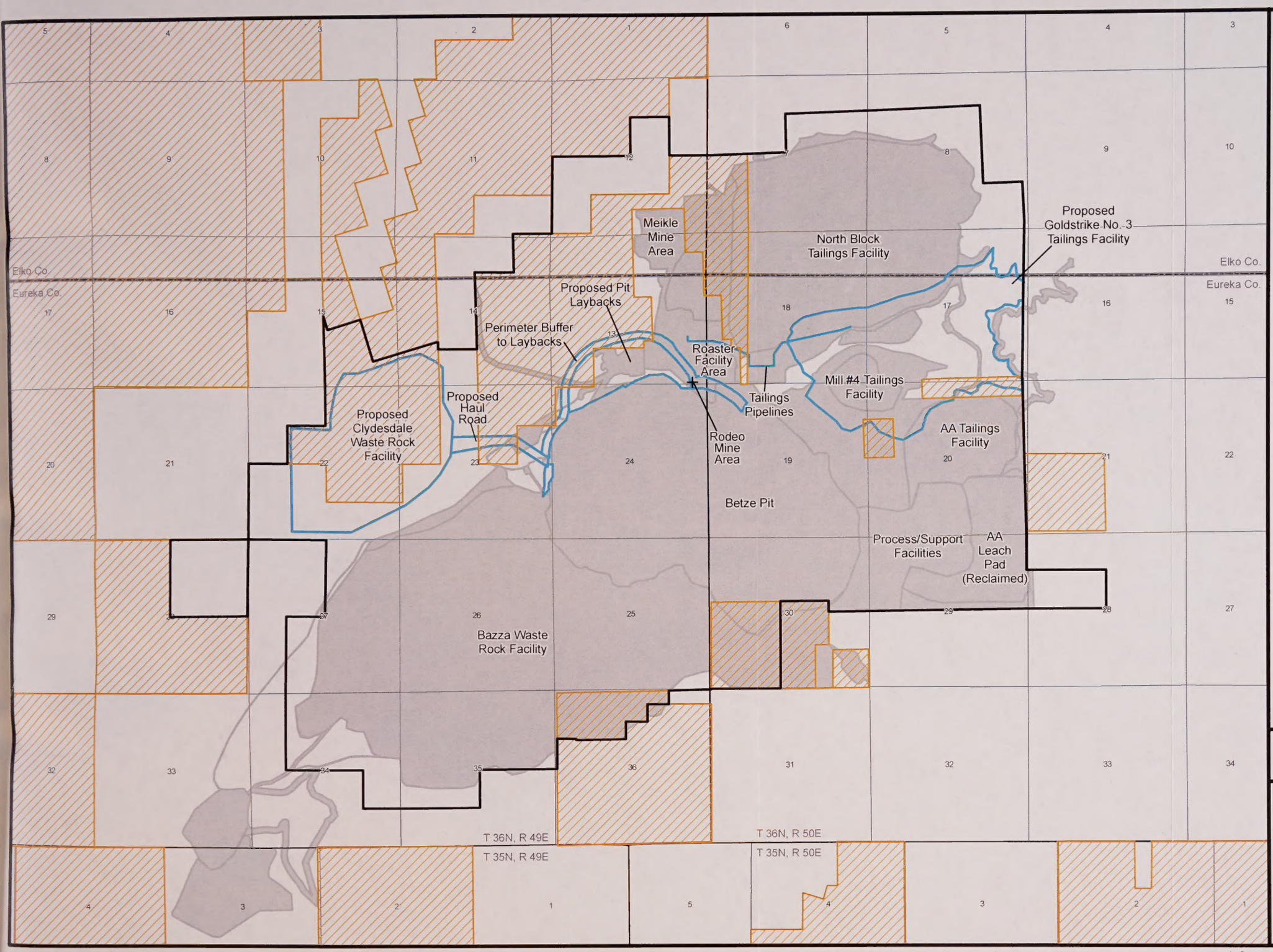
Source: BGMI and SRK 2007.

Betze Pit Expansion Project

Figure 1-1

General Location Map

04/21/08



LEGEND

- Goldstrike Mine Operations Boundary
- Publicly Owned (BLM) Land[1]
- Existing and Authorized Facilities Disturbance
- Proposed Disturbance

[1] Disturbed areas shown outside of the BGMI Mine operations boundary are Newmont Mining Corporation disturbances.

Note: All non-BLM land is privately owned.

Source: BGMI and SRK 2007; BLM 2007 Data Transmittal; BGMI 2007 Data Transmittal.

N W E S

0 0.5 1 Miles

Betze Pit Expansion Project

Figure 1-2

Site Map of Surface Ownership



sellers agreeing on a specific transaction price, which reflects the current supply and demand for the commodity and other factors.

The BLM is responsible for managing mineral rights access on certain federal lands as authorized by the General Mining Law of 1872, as amended. Under the law, persons are entitled to reasonable access to explore for and develop mineral deposits on public domain lands that have not been withdrawn from mineral entry.

In order to use public lands managed by the BLM's Elko District Office, BGMI must comply with the BLM Surface Management Regulations (43 CFR 3809) and other applicable statutes, including the Mining and Mineral Policy Act of 1970 (as amended) and FLPMA. The BLM must review BGMI's plans for expanding and developing the Betze Pit Expansion Project to ensure the following:

- Adequate provisions are included to prevent unnecessary or undue degradation of federal lands and to protect the non-mineral resources of the federal lands;
- Measures are included to provide for reclamation of disturbed areas; and
- Compliance with applicable state and federal laws is achieved.

1.2 Relationship to BLM and Non-BLM Policies, Plans, and Programs

1.2.1 Federal Land Use Plan Conformance

As noted above, the BLM has the responsibility and authority to manage the surface and subsurface resources on public lands located within the jurisdiction of the Elko District Office, and it has designated lands within the project area as open for mineral exploration and development. In its Record of Decision (ROD) for the Elko Resource Management Plan (RMP) (BLM 1987), the BLM states in its objective under minerals that it will: "Maintain public lands open for exploration, development, and production of mineral resources while mitigating conflicts with wildlife, wild horses, recreation, and wilderness resources." The management decision applicable to this objective is as follows (BLM 1987): "Designate the resource area open to mineral entry for locatable minerals, except for an 11-acre administrative site in the City of Elko." The Proposed Action and alternatives, as described and analyzed in this SEIS, conforms to the Elko RMP (BLM 1986a).

1.2.2 State and Local Land Use Plans and Policies

The State of Nevada recognizes that mining is an important contributor to the state's economy and encourages the development of mineral resources. In Nevada Revised Statute (NRS) 519A.010, the state policy towards mining and reclamation as defined by the Legislature is:

"(a) The extraction of minerals by mining is a basic and essential activity making an important contribution to the economy of the State of Nevada;

(b) Proper reclamation of mined land, areas of exploration and former areas of mining or exploration is necessary to prevent undesirable land and surface water conditions detrimental to the ecology and to the general health, welfare, safety and property rights of the residents of this state; and

(c) The success of reclamation efforts in this state is dependent upon cooperation among state and federal agencies."

The proposed project is consistent with state policies.

The Eureka County Master Plan (Eureka County 1997) provides only general policy guidance and not site-specific control. However, Eureka County, in cooperation with the Nevada Division of State Lands, has adopted a Policy for Public Lands within its jurisdiction (Eureka County 1985). The proposed project is consistent with the policies in this plan, which includes promoting expansion of mining operations/areas.

Elko County, in cooperation with the Nevada Division of State Lands, is developing an Elko County Public Lands Policy Plan (2007). Details of this plan are not yet available. Elko County is in favor of approval of the mine plan.

1.3 Authorizing Actions

In addition to the SEIS, implementing the Proposed Action would require authorizing actions from other federal, state, and local agencies with jurisdiction over certain aspects of the proposed project. **Table 1-1** lists the required permits or approvals that are already in place or would be obtained and the responsible regulatory agencies. BGMI is responsible for amending existing permits and applying for and acquiring additional permits, as needed. **Appendix A** provides additional permitting and approval information.

Table 1-1 Major Permits and Approvals

Permit / Approval	Granting Agency
Supplemental Environmental Impact Statement Plan of Operations Approval Right-of-Way (ROW) Permits	U.S. Department of the Interior, BLM
Explosives Permit	Bureau of Alcohol, Tobacco, and Firearms
Section 106 National Historic Preservation Act	Programmatic Agreement BLM and State of Nevada Historic Preservation Office
Review of jurisdictional determinations for Clean Water Act (CWA) Section 404 permitting	U.S. Army Corps of Engineers (USACE)
Surface Disturbance Permit Permit to Construct Permit to Operate (Title V) Nevada Mercury Control Program Operating Permit	Nevada Department of Conservation and Natural Resources, Nevada Division of Environmental Protection (NDEP), Bureau of Air Pollution Control
Water Pollution Control Permit Reclamation Permit	Nevada Department of Conservation and Natural Resources, NDEP, Bureau of Mining Regulation and Reclamation (BMRR)
Permit to Appropriate Water Permit for Dam Construction (Tailings/Water)	Nevada Department of Conservation and Natural Resources, NDEP, Division of Water Resources
Industrial Artificial Pond Permit	NDOW
Approval to Operate a Sanitary Landfill	Nevada Department of Conservation and Natural Resources, NDEP, Bureau of Waste Management
General Storm Water Permit General Permit to Operate and Discharge	Nevada Department of Conservation and Natural Resources, NDEP, Bureau of Water Pollution Control
Permit to Operate	Nevada State Minerals Commission, Division of Minerals
Hazardous Materials Storage Permit	State of Nevada, Fire Marshal Division
Road Construction Applications Building Permits	Eureka County Elko County

1.4 SEIS Organization

This SEIS follows the CEQ recommended organization (40 CFR 1502.10). Chapter 1.0 provides descriptions of the purpose and need for the action, the role of the BLM in the SEIS process, and the required regulatory actions for the proposed project. Chapter 2.0 describes the Proposed Action and alternatives, including the No Action Alternative. Chapter 3.0 describes the affected environment and the direct, indirect, and cumulative impacts associated with the Proposed Action and alternatives; possible mitigation to reduce or minimize impacts; and any residual adverse effects following the implementation of mitigation. Chapter 4.0 summarizes public participation and the scoping process and the consultation and coordination undertaken to prepare the SEIS. Chapter 5.0 presents the list of SEIS preparers and reviewers. Chapter 6.0 presents the list of references, acronyms and abbreviations, glossary, and index. Copies of supporting documents are on file at the BLM Elko District Office in Elko, Nevada.

1.5 Summary of Major Issues

Four major issues associated with the Proposed Action are discussed in this SEIS. They include:

- Mule deer migration corridor disruption during the construction of Clydesdale Waste Rock Facility before the Bazza Waste Rock Facility is fully reclaimed;
- Betze Pit lake water quality and associated effects;
- Mercury emissions resulting from extended roaster facility use; and
- Social and economic value to the community from extended employment and operations on site.

DESCRIPTION OF ALTERNATIVES INCLUDING THE PROPOSED ACTION

CHAPTER 2

2.0 Description of Alternatives Including the Proposed Action

2.1 Introduction and Background Action

This chapter describes the Proposed Action as set forth by BGMI in the Amendment to the POO (NVN-70708) and Reclamation Permit (0026) for Expansion of the Betze Pit, the Goldstrike No. 3 Tailings Facility, and the Clydesdale Waste Rock Facility (BGMI and Consulting [SRK] 2007) and supporting plans. Chapter 2.0 also presents other alternatives, including the No Action Alternative, that are analyzed in the SEIS, and other potential alternatives that were considered but eliminated from detailed analysis. A comparative analysis of project alternatives is presented in Chapter 2.0, Section 2.6. The BLM's preferred alternative is identified in Chapter 2.0, Section 2.7, BLM-preferred Alternative.

BGMI acquired the interest of Western States Minerals JV-1 in the Goldstrike Mine in December 1986. Since that time, BGMI has continued mining exploration and development activities. In December 1987, the BLM approved a BGMI POO amendment to construct a mill and tailings impoundment at the Goldstrike Mine. In April 1989, BGMI prepared a POO to expand existing facilities. The 1991 Betze Project Environmental Impact Statement (EIS) (BLM 1991a,b) addressed the environmental impacts and mitigation associated with the proposed expansion of the gold mining and processing operations at the Goldstrike Mine. The principal components of the Proposed Action included expansion of the existing Post Pit into the Betze Pit (to mine deeper, sulfide ores), an extension of the South waste rock disposal area, expanded dewatering facilities, addition of the North Block heap leach facility, mill expansion, addition of the North Block tailings impoundment, two ore stockpiles, topsoil stockpiles, and haul roads and pipeline corridors (BLM 1991a,b). The mine expansion was approved by the BLM (1991c).

In 1994, BGMI received patents under the General Mining Law to 1,793 acres of land on which the Betze-Post Mine, the Meikle Mine, and most of BGMI's milling and beneficiation operations are situated. BGMI has completed additional land exchanges with the BLM since 1991 when the Betze Project Final EIS and ROD were released. In December 1994, the BLM issued a Finding of No Significant Impact and decision record to approve the Millsite Land Exchange (BLM 1994b). In this land exchange, BGMI acquired title to 1,827.5 acres of public lands that were subject to BGMI's unpatented millsite claims within or adjacent to BGMI's mining and milling operation. In return, the BLM acquired title to 403.3 acres of private land along the South Fork of the Humboldt River that had important resource values. The land exchange resulted in consolidation of land ownership for both BLM and BGMI (BLM 1994c).

A second land exchange to consolidate land ownership occurred between BGMI and the BLM in 1995. The Section 31 land exchange (BLM 1995) resulted in BGMI acquiring title to 1,279 acres of public land that was subject to BGMI's unpatented mining claims within or adjacent to BGMI's mining and milling operations. The BLM acquired title to 690 acres along the South Fork of the Humboldt River in return (BLM 1995).

On May 3, 1999, Newmont Gold Company and BGMI completed a transaction known as the asset exchange. The purpose of the asset exchange was to rationalize the ownership and control of both the surface and subsurface estates that were jointly owned by the parties and to reduce the number of complex agreements that were needed to permit efficient operation and development of properties owned by both companies.

Prior to the exchange, BGMI's land position consisted of three "islands." These islands were the millsite block, where the autoclaves, shops, offices and other support facilities are located; the south block, which hosts the Betze-Post open pit mine and the Deep Post underground deposit; and the north block, where the Meikle, Rodeo, and Gold Bug deposits, the roaster, and the main tailings facility are located. BGMI also owned an interest in what is now known as the Leeville underground mine several miles to the south. At that time, Newmont owned the corridors between the three "islands," and most of the surrounding land. Newmont's ownership included a portion of the Betze-Post open pit mine, the Deep Post underground deposit, the Leeville deposit, and the Gold Bug deposit as well as several satellite deposits, some of which were shared with BGMI.

The transaction was structured as a like-kind land exchange. In the exchange, BGMI transferred to Newmont: 1) BGMI's share of the Deep Post underground deposit along with a 200-acre corridor of subsurface land that connects the Deep Post underground deposit with Newmont's Deep Star deposit, and 2) its 40 percent interest in the Leeville deposit. In return, Newmont transferred to BGMI: 1) the land in the corridors between the three BGMI islands and some adjacent surface land, 2) Newmont's share of the Goldbug deposit and Barrel resource, and 3) its share of the ore body in the Betze-Post open pit.

As a result of these exchanges, BGMI obtained: 1) the land needed for the development of the west end of the Betze-Post open pit; 2) control of the open pit, including the right to backfill the pit; 3) control of other lands important to its security that were needed for waste rock facilities; and 4) the underground deposits adjacent to its Meikle and Rodeo ore bodies. Current land ownership is described in **Figure 1-2**. In addition to receiving the above described underground deposits, Newmont was provided access to the bottom of the Betze-Post open pit that permitted early development of the Deep Post deposit, the synergy attributable to mining the Deep Post deposit through its infrastructure, consolidation of the High Desert properties with its adjacent properties, and the resource and exploration potential associated with the 200-acre corridor and the High Desert properties.

A SEIS for the Betze Project (BLM 2000a, 2003a) was prepared to evaluate new information relating to Goldstrike Mine groundwater pumping and water management operations as a result of new monitoring data obtained since the ROD for the 1991 EIS. The SEIS updated the potential water management operations impacts and mitigation from the 1991 EIS for the Betze Project. The SEIS also addressed the environmental impacts of a proposed buried water line that was proposed by the applicants, BGMI and Elko Land and Livestock Company (ELLCO). The proposal for the water line was subsequently withdrawn.

In association with the SEIS (BLM 2000a, 2003a), a report was prepared entitled Cumulative Impact Analysis (CIA) of Dewatering and Water Management Operations for the Betze Project, South Operations Area Project, and Leeville Project (BLM 2000b). This report addressed potential cumulative impacts to groundwater and surface water and associated water-dependent resources as a result of the three mining operations.

BGMI currently proposes to expand their existing operations to facilitate further mining of the Betze ore deposit. The proposed expansion, known as the Betze Pit Expansion Project, would combine existing and proposed mining facilities and accelerate reclamation of the Bazza Waste Rock Facility at the Goldstrike Mine.

2.1.1 Current Mining Disturbance

The Goldstrike Mine operations area is composed of approximately 10,370 acres of which approximately 1,845 acres are public lands administered by the BLM and 8,525 acres are owned by BGMI (**Figure 1-2**). A total disturbance of 7,882 acres is currently authorized for the mine. The majority (89 percent) of the total authorized disturbance would occur on private lands owned by BGMI. The remainder (11 percent) of the authorized disturbance would occur on public lands administered by the BLM Elko District Office. The present public and private authorized surface disturbance is listed in **Table 2-1**.

2.2 No Action Alternative

The No Action Alternative is to continue mining and processing operations at the existing Goldstrike Mine under the terms of current permits and approvals as authorized by the BLM and the State of Nevada. **Appendix A** provides a summary list of permits and authorizations currently in place at the Goldstrike Mine. **Table 1-1** lists the required permits or approvals that are already in place or would be obtained and the responsible regulatory agencies.

Table 2-1 Currently Authorized Goldstrike Mine Disturbance

Facility	Public (acres)	Private (acres)	Total
Waste rock disposal areas	288	2,555	2,843
Heap leach pads	0	256	256
Tailings facilities	100	1,204	1,304
Surface facilities	0	99	99
Yards and access	371	561	932
Post Mill 4	9	202	211
Ponds	0	43	43
Haul and access roads	55	166	221
Sediment control	0	274	274
Water treatment facilities	5	152	157
Sand Dune Springs recirculation system	0	11	11
Boulder Valley discharge facility	0	8	8
Pit	19	1,393	1,412
Brush Creek diversions	0	68	68
Buttress for North Block Tailings Facility	0	43	43
Total	**847**	**7,035**	**7,882**

Source: NDEP 2007a.

Existing facilities and activities at the Goldstrike Mine include an open pit (Betze Pit) and underground mining (Meikle and Rodeo mines); processing with associated tailings disposal facilities; mill, roaster, and autoclave facilities with associated support facilities; and ancillary facilities (**Figure 2-1**). The Goldstrike Mine facilities are located on private land controlled by BGMI, with the exception of a small parcel on the North Block tailings storage facility embankment and the roaster ore stockpile, and two parcels located within the Bazza waste rock facility. These parcels are located on public lands administered by the BLM Elko District Office. The Goldstrike Mine is currently authorized to disturb up to 7,035 acres of private land and 847 acres of public land.

Existing primary facilities associated with the Goldstrike Mine are shown in **Figure 2-1,** and summarized below.

- Betze Pit;
- Bazza Waste Rock Facility;
- AA Heap Leach Facility (reclaimed);
- Mill Facility, inclusive of crushing and grinding facilities, a roaster, autoclaves, a carbon-in-leach (CIL) circuit, and chemical reagent storage area;
- Underground mines (Meikle and Rodeo);
- Ore stockpiles;
- Tailings facilities (North Block, AA, and Mill #4);

- Blasting materials storage area; and
- Ancillary support facilities (offices, assay lab, shop/warehouse, maintenance, water management, power, fuel storage, and haul roads).

2.2.1 Current Mining Operations or Facilities that will Continue Unchanged

Some existing operations or facilities would not change as a result of the Proposed Action or alternatives considered in detail. This section describes current operations or facilities at the Goldstrike Mine that would not be affected by the Proposed Action or an alternative selected for detailed analysis. These operations are not affected by the Proposed Action or the alternatives because there would be no changes to currently authorized operations as a result of the Proposed Action or alternatives, and there would be no impacts not already anticipated from continued authorized operations.

Mining operations or facilities not affected by the Proposed Action or alternatives include the following:

- Meikle Mine;
- Rodeo Mine;
- Drilling and blasting techniques;
- Ore and waste rock loading and hauling procedures;
- Ore stockpiling and processing methods (crushing and grinding facilities, autoclaves, roasters, CIL gold recovery circuits, chemical reagent storage area);
- Heap leach facilities (in reclamation);
- Some of the existing infrastructure such as roads, utilities, water supply, sanitary and solid waste disposal, and fencing and site security;
- Ancillary support facilities (e.g., offices, laboratories, shops/warehouses); sanitary and solid waste treatment/disposal facilities; fencing; and site security;
- Exploration;
- Hazardous materials and waste management;
- Safety and fire protection; and
- Water management operations.

A brief description of each existing operation or facility follows. Current applicant-committed environmental protection measures will continue to be implemented as discussed in Section 2.2.1.13.

2.2.1.1 Meikle Mine

BGMI began production from the Meikle Mine in 1996. The location of the Meikle Mine is shown in **Figure 2-1**. BGMI initiated production from the upper levels of the Meikle deposit using transverse longhole stoping and underhand drift and fill mining methods. During 1999, BGMI extended the production shaft to a depth of 1,800 feet to provide access to the lower levels of the Meikle deposit. The ventilation shaft has been completed to a depth of 1,320 feet. Current production rates from this mine average 1,800 tons of ore per day. Production from the Meikle Mine is scheduled to continue through 2016. A more complete description of the Meikle Mine is provided in the Meikle Mine Development Environmental Assessment (EA) (BLM 1993).

2.2.1.2 Rodeo Mine

BGMI developed an exploration shaft at the Rodeo deposit, just south of the Meikle Mine, in 1998. The location of the Rodeo exploration shaft is shown in **Figure 2-1.** This shaft provided BGMI with underground access to explore the Griffin deposit, located between the Rodeo shaft and the Meikle Mine, as well as the

Number	Project Facility
1	Meikle Power Substation
2	Meikle Facilities
3	Roaster Ore Stockpiles General Area
4	Reclaim Pond
5	Roaster Crusher
6	Roaster Pond Stockpile Containment Pond
7	Roaster Buildings
8	Blasting Facility
9	Rodeo Facilities
10	Containment Pond
11	Ore Stockpile
12	Seepage Vault
13	Containment Pond
14	Stockpile Containment Pond
15	Mill #4 Seepage Pond
16	Rodeo Backfill Shaft
17	Dewatering White Ponds General Area
18	Bazza Power Substation
19	AA Seepage Pond General Area
20	Reclamation Pond General Area
21	AA Ore Stockpile General Area
22	AA Fuel Storage Tanks
23	Valdez Containment Pond
24	Primary Crusher
25	Truckshop Facility
26	Grinding & CIL Facility
27	Process Maintenance
28	Autoclave Facility
29	Assay Lab
30	Administration Building
31	Dewatering Shop Area
32	Power Substation
33	Ore Stockpile General Area
34	North Block Power Substation
35	Waldon's Containment Pond
36	Ore Stockpile General Area
37	Ore Stockpile General Area

Meikle Mine Area
North Block Tailings Facility
Elko Co.
Eureka Co.
Ore Stockpile
Mill #4 Tailings Facility (Inactive)
AA Tailings Facility
Betze Pit
AA Leach Pad (Reclaimed)
Mill and Support Facilities
Bazza Waste Rock Facility
Water Treatment Facility (Inactive)
TS Ranch Reservoir Area
T 36N, R 49E
T 35N, R 49E
T 36N, R 50E
T 35N, R 50E

LEGEND

- Goldstrike Mine Operations Boundary
- Tailings Facilities
- Waste Rock Facility
- Open Pit
- Leach Pad
- Mill and Support Facilities
- Previous Disturbance

Note: Disturbed Areas Shown Outside the BGMI Mine Operations Boundary are Newmont Mining Corporation Disturbances.

Source: BGMI and SRK 2007; BGMI 2007a.

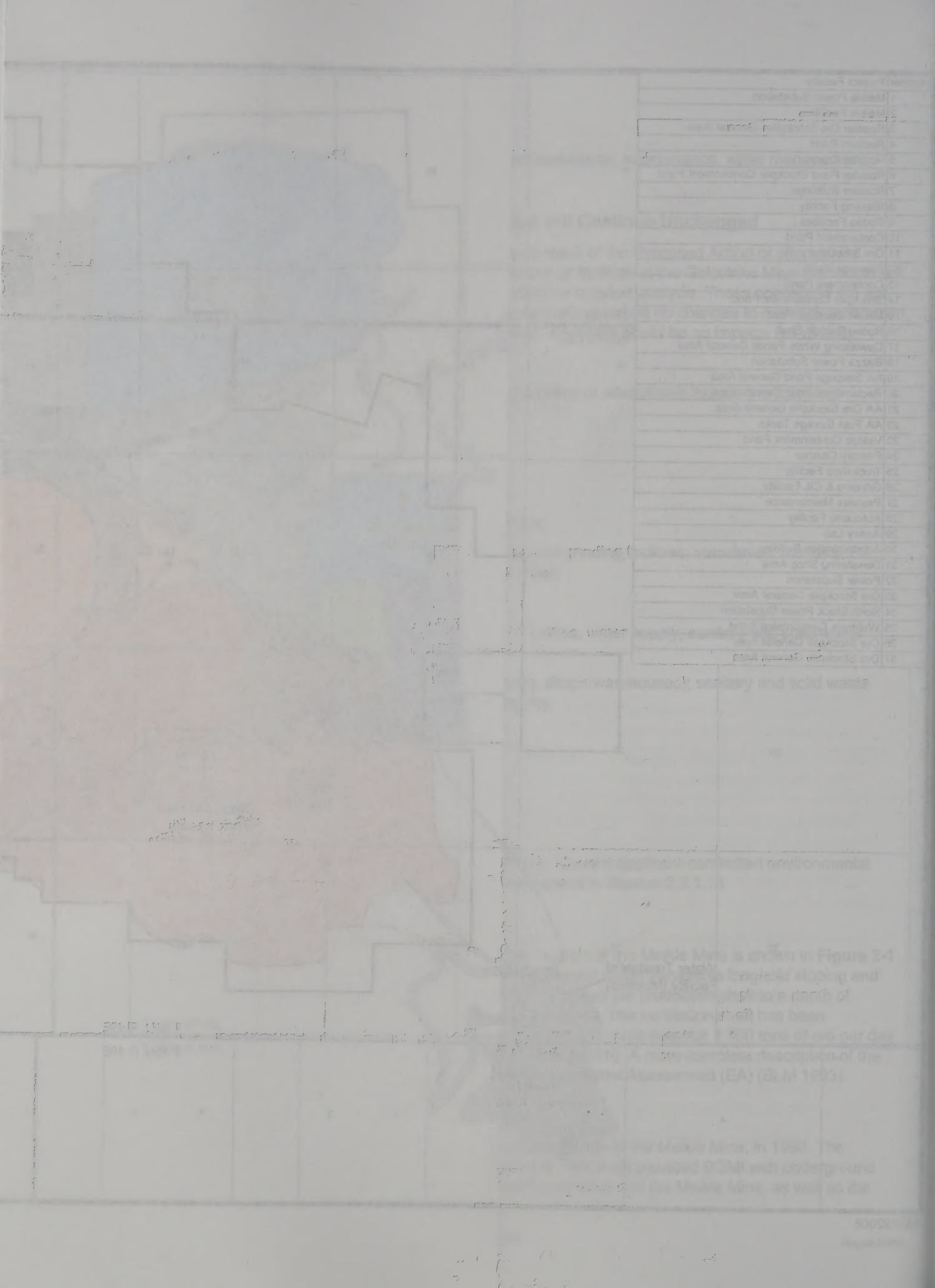
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Betze Pit Expansion Project

Figure 2-1

Detail of Existing Goldstrike Mine Facilities



Rodeo deposit. As part of an asset exchange with Newmont that was completed in May 1999, BGMI acquired the Goldbug deposit, located south of the Rodeo shaft. BGMI initiated underground drift development from the Rodeo shaft to the Goldbug deposit in mid-1999. The Goldbug and Griffin deposits are currently being mined. The Rodeo mine is active and produces an average of 2,300 tons of ore per day. Production from the Rodeo Mine is scheduled to continue through 2016.

2.2.1.3 Drilling and Blasting Techniques

Current mining operations use conventional drilling and blasting techniques. Ore and waste rock is first drilled using large diameter blasthole drilling rigs. The holes are then charged with ammonium nitrate and fuel oil or blasting slurry during wet conditions and blasted. Blasting is performed only during daylight hours and under strict safety procedures as required by the Department of Homeland Security, Mine Safety and Health Administration (MSHA), and the State of Nevada.

2.2.1.4 Ore and Waste Rock Loading and Hauling

The resultant broken rock from blasting is excavated on production benches using electric and hydraulic shovels. Haul trucks having carrying capacities of approximately 330 tons are used to transport the ore and waste rock out of the pit. The ore and waste rock is hauled to either: 1) the Bazza Waste Rock Facility, 2) ore processing facilities, 3) ore stockpiles, 4) tailings disposal facilities during construction, or 5) in pit waste rock backfill.

2.2.1.5 Ore Stockpiling and Processing Methods

BGMI has constructed milling and beneficiation facilities on BGMI's private land as depicted in **Figure 2-1**. The milling facilities include two separate mill circuits that are presently capable of handling approximately 36,000 tons of ore per day. The ore passes through a grinding circuit followed by ore oxidation through a pressure oxidation circuit (autoclaves) or roasting facility depending on ore type, followed by a CIL gold recovery process. The ore slurry, referred to as tailings, is treated with Caro's acid or the International Nickel Company (INCO) process to neutralize residual cyanide, and the slurry is pumped to BGMI's AA and North Block Tailings Facilities. The tailings solids settle in the impoundment and the fluids are recycled to the mill for continued use. The roaster started operating in 2000 and has a nominal capacity of 16,500 tons per day. Refer to Section 1.4.2.5 in the Betze Project Draft SEIS (BLM 2000a) and Sections 2.1.4.2 and 2.2.3.2 of the Betze Project Draft EIS (BLM 1991a) for a more complete description of the milling and beneficiation processes. At present, BGMI produces approximately 1,580,000 ounces of gold per year from its milling facilities. The location of the existing ore stockpiles is shown in **Figure 2-1**.

2.2.1.6 Heap Leach Facilities

The North Block Heap Leach Facility, which was located on the North Block, has been decommissioned, the spent leach material removed to the North Block Tailings Impoundment, and the facilities removed to facilitate development of the North Block Tailings Impoundment embankment and ore stockpiles in the area. The AA Heap Leach Facility has been decommissioned and reclaimed and is now undergoing closure.

2.2.1.7 Existing Infrastructure

Roads

There are four types of roads on the mine property: BLM ROW, access, haul, and exploration roads. The main access road begins at Newmont's Mill No. 1 and continues north for 5.1 miles onto land controlled by BGMI. Haul roads connect the Betze Pit and the Meikle and Rodeo underground mines to the Bazza Waste Rock Facility, the ore processing facilities, and the ore stockpiling areas.

Electric Utilities

Electrical power is transmitted to the mine by the Sierra Pacific Power system. Electrical facilities include three main substations (Mill, South Block, and Bazza substations), several smaller substations throughout the property, and transmission lines.

Water Supply

Water used for processing and dust suppression is obtained from the existing mine dewatering program discussed in Section 2.2.1.12, Water Management Operations.

Sanitary and Solid Waste Disposal

Sanitary waste generated at the mine is collected and treated at the existing sewage treatment facilities. Effluent from the sewage treatment plants are pumped to the mill for disposal in the tailings facilities.

Non-toxic, non-hazardous solid waste materials generated currently are, and would continue to be, disposed of in the currently approved Class III waivered landfill. Disposal of non-toxic, non-hazardous solid wastes is conducted in accordance with all applicable federal, state, and county laws and regulations.

Fencing and Site Security

Operation of the existing security system in place at the Goldstrike Mine would continue. Access to the Goldstrike Mine is controlled by a gatehouse at the entrance to the site. Existing fences would be maintained to prevent access by wildlife and livestock and to provide for public safety.

2.2.1.8 Ancillary Support Facilities

Existing ancillary support facilities would be used to support the Proposed Action and alternatives. These facilities include the mine and maintenance buildings, administrative offices and technical buildings, emergency medical and safety station, warehouses, metallurgical and assay laboratory facilities, water treatment facility, diesel and gas storage facilities, and explosives storage.

2.2.1.9 Exploration

Ongoing exploration activities are conducted within the Goldstrike operations boundary per existing approvals, including BGMI POO N16-98-002P, to identify and delineate any additional ore reserves. Drilling also is conducted to confirm the grade of ore deposits or confirm that an area contains no economically recoverable gold (i.e., condemnation drilling). These activities consist of surface geologic or geophysical surveys, access road grading or construction, and exploration or condemnation hole drilling programs for surface and underground areas. Current exploration activity is occurring in the vicinity of the Meikle Mine area.

2.2.1.10 Hazardous Materials and Waste Management

Procedures for transportation, storage, waste management, and spill prevention and emergency response programs for hazardous materials currently are in place and implemented for the existing operations, as described in the Environmental Incident Response Manual (BGMI 2007b). There would be no change in the current reagent consumption rate at the existing mill to facilitate the processing of ore mined in the proposed expansion. As a result, on site reagent storage and usage at the existing facilities would continue to be covered under the existing permits. Fuel, lubricant, antifreeze, solvents, and explosive materials transportation, use, and storage also are covered under existing permits.

The majority of hazardous materials currently used on site are spent or consumed during operations. Materials that are not spent or consumed (antifreeze, solvents) are recycled, or disposed of off site in an approved depository in accordance with BGMI's Solid and Hazardous Waste Management Plan (JBR Consultants [JBR] 2006) and all applicable federal and state regulations.

2.2.1.11 Safety and Fire Protection

The existing facilities operate in conformance with all MSHA safety regulations (30 CFR 1-199). Site access is restricted to employees and authorized visitors. Fire protection equipment and a fire protection plan have been established for the Goldstrike Mine in accordance with Nevada State Fire Marshal standards. The current fire protection plan at the mine would be implemented for the proposed project.

2.2.1.12 Water Management Operations

Current water management operations (pumping of groundwater and related operations) would continue through 2015 under existing permits from the State of Nevada. The purpose of the pumping of groundwater, also described as dewatering, is to maintain the current water table below the Meikle Mine. Dewatering is no longer required for mining the Betze Pit.

Under the No Action Alternative, groundwater pumping to support mine operations would continue through 2026. Between 2008 and 2015, dewatering pumping rates would steadily diminish from a maximum of approximately 16,200 to 10,700 gallons per minute (gpm). An average of approximately 2,350 gpm of groundwater would be pumped for up to an additional 11 years beyond 2015 while mine reclamation and mineral processing activities continue. A summary of the dewatering, disposal rates, and water balance estimates for the No Action Alternative is shown in **Table 2-2**.

BGMI's water management operations for the Goldstrike Mine include a system of dewatering wells, water gathering and conveyance facilities, water storage, water use, and various management options for discharge of excess water. The current authorized water management components include the following:

- Mine dewatering wells and water collection system;
- TS Ranch Reservoir;
- Springs and sand dune canal;
- Irrigation in Boulder Valley;
- Infiltration;
- Injection;
- Sand Dune drainage embankments; and
- Humboldt River discharge authorization.

These components of the water management operations are described in more detail below.

Dewatering Operations, Wells, and Collection Systems

Dewatering of the Betze Pit is accomplished through the use of perimeter wells located peripheral to the pit area, in-pit wells, horizontal drains installed for passive dewatering of pit walls, and water collection sumps installed in the bottom of the pit. BGMI's dewatering activities are conducted in compliance with its approved water appropriations issued by the Nevada State Engineer's Office.

Dewatering operations for the Betze Pit were initiated in February 1990 to lower the groundwater level in order to mine the Betze deposit. **Figure 2-2** shows the historical groundwater level elevations from monitoring wells and the pumping rates monitored to dewater the Betze Pit. The groundwater elevations were approximately 5,265 feet above mean sea level (amsl), (United States Geological Survey [USGS] datum) in the pit area prior to dewatering operations. Dewatering rates increased steadily to over 60,000 gpm within the first quarter of 1993 with groundwater levels lowered to approximately 4,600 feet amsl. Average pumping rates generally remained above 60,000 gpm until 1995 with groundwater levels declining to below 4,100 feet amsl. In 1995

Table 2-2 Life of Mine Water Budget Summary Table for BGMI (annualized gpm) (No Action Alternative)

Year	Dewatering Rate	Delivered from Leeville	Sand Dune Canal Flow	Evaporation and Storage	Mine Processing[1]	Total Irrigation	Humboldt River Discharge	Total Reservoir Infiltration
2008	16,165	9,000	5,391	794	5,733	10,928	0	10,448
2009	14,407	15,417	4,393	1,080	3,734	15,361	0	11,934
2010	12,953	14,949	3,822	997	3,734	13,233	0	11,871
2011	12,033	9,076	3,166	704	3,734	9,397	0	8,769
2012	11,527	6,153	2,025	555	3,734	7,633	0	6,596
2013	11,193	4,781	1,018	484	3,734	6,647	0	5,430
2014	10,931	4,042	360	440	3,734	5,890	0	4,958
2015	10,686	3,605	63	412	3,734	5,468	0	4,676
2016	2,350	0	0	0	2,350	0	0	4,884
2017	2,350	0	0	0	2,350	0	0	0
2018	2,350	0	0	0	2,350	0	0	0
2019	2,350	0	0	0	2,350	0	0	0
2020	2,350	0	0	0	2,350	0	0	0
2021	2,350	0	0	0	2,350	0	0	0
2022	2,350	0	0	0	2,350	0	0	0
2023	2,350	0	0	0	2,350	0	0	0
2024	2,350	0	0	0	2,350	0	0	0
2025	2,350	0	0	0	2,350	0	0	0
2026	2,350	0	0	0	2,350	0	0	0

[1]Water utilized for mine processing is consumed, released as steam, lost through evaporation, or is trapped within tailings as interstitial solution.

Source: BGMI 2007a.

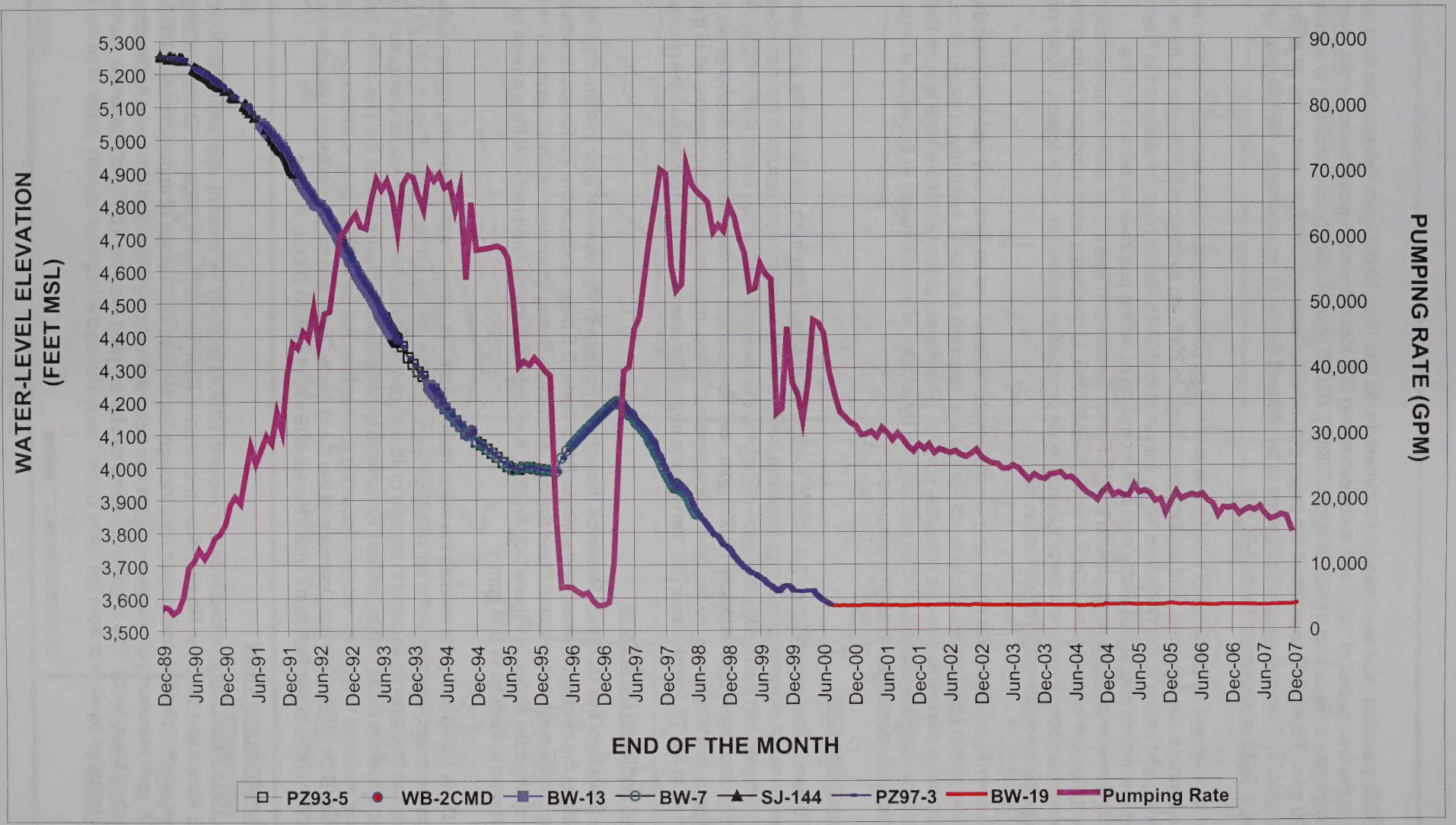


Figure 2-2 Betze Pit Dewatering Rates and Groundwater Level Elevations from Monitoring Wells

Source: Zhan 2008.

and 1996, pumping rates were reduced substantially (to less than 10,000 gpm between the third quarter of 1996 to the first quarter of 1997) with a corresponding 200-foot rebound in groundwater levels. Average pumping rates increased to a peak of approximately 70,000 gpm in 1998 before declining to approximately 17,000 gpm in July 2007 to maintain the target groundwater level of 3,576 feet amsl in the pit area (BGMI 2007c). Pumping rates are projected to be reduced further to approximately 10,700 gpm by the end of mining in 2015 as shown on **Table 2-2**.

Water is conveyed by pipelines to various use areas (e.g., process water tanks and mill facilities, water trucks for dust control, sanitary uses, and exploration drilling). In 2006, an average of 5,736 gpm of water was used for mining and milling at the Goldstrike Mine, delivered to BGMI's Meikle Mine, or delivered to Newmont for mining and milling use. Water that is not used for mining or milling purposes is delivered to the 72-inch-diameter gravity flow pipeline to the TS Ranch Reservoir (**Figure 2-3**). BGMI is authorized by a discharge permit issued by the NDEP, Permit #NEV89068, to discharge water produced by its groundwater pumping operations to groundwaters of the state via percolation, infiltration, and irrigation. Water storage is provided by the existing TS Ranch Reservoir.

The Goldstrike Mine process sites are "zero discharge facilities" and as such, any water entering the facility must stay within containment. Water is consumed and released as steam, lost through evaporation, or is trapped within the tailing mass as interstitial solution. The climate at the Goldstrike Mine is such that evaporation potential exceeds annual precipitation by a factor of approximately 4; therefore, a large amount of water is easily consumed through evaporation.

TS Ranch Reservoir

The TS Ranch Reservoir (**Figure 2-3**) stores excess dewatering water from the Goldstrike and Newmont's Leeville mines. A naturally occurring permeable fracture in the reservoir floor results in the majority of the water being infiltrated into the rhyolite formation underlying the reservoir (authorized under #NEV89068). BGMI currently discharges approximately 10,000 gpm, and Newmont's Leeville operations discharge approximately 9,000 gpm, to the reservoir via the gravity flow pipeline. When irrigation does not consume all of the water delivered to the TS Ranch Reservoir, the water is treated for arsenic prior to discharge in the reservoir.

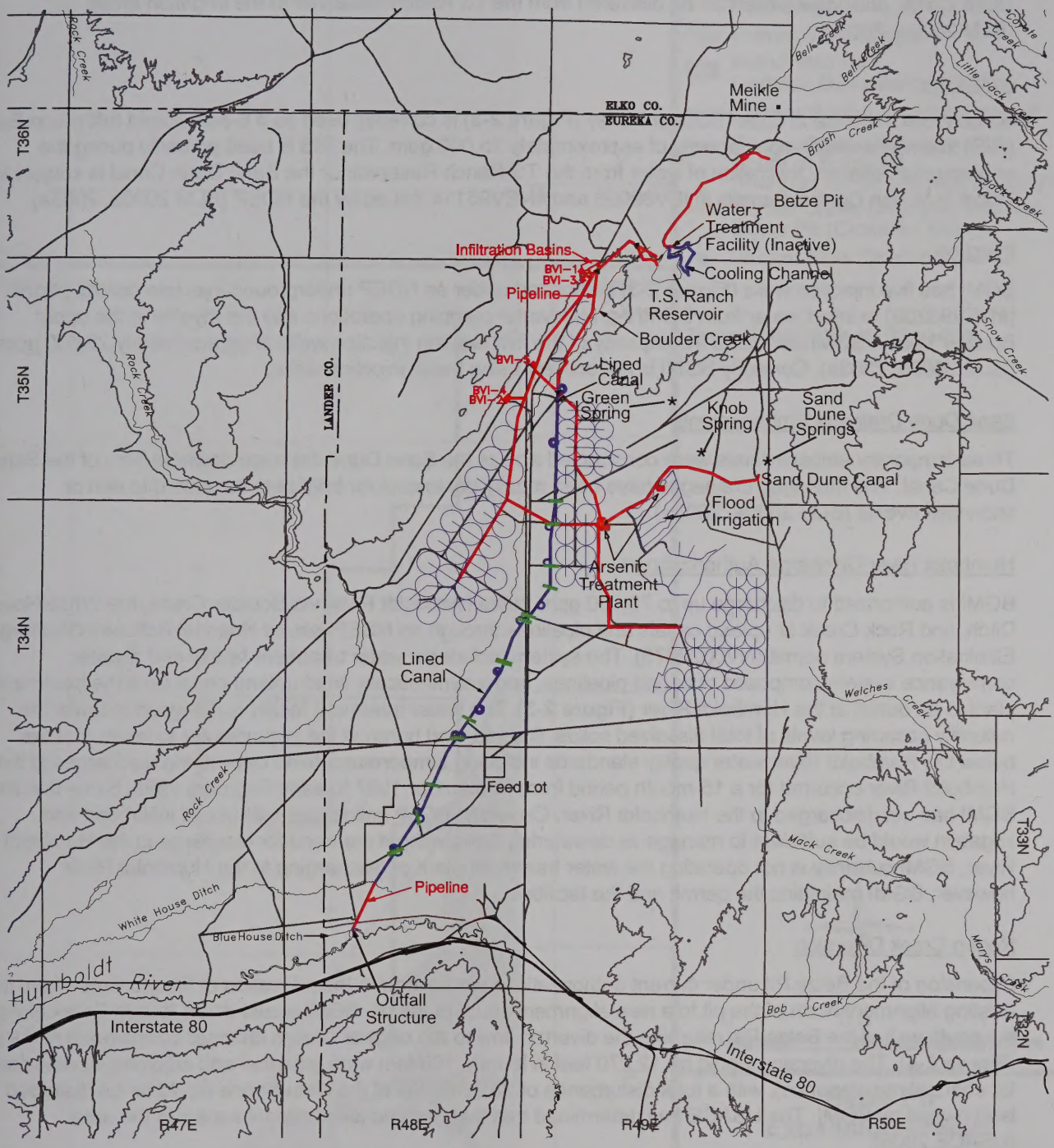
Springs and Sand Dune Canal

Water flows from the TS Ranch Reservoir through the fracture in the reservoir floor into the rhyolite formation, resulting in the creation of three new springs: Sand Dune (5.5 miles south of the TS Ranch Reservoir), Knob Spring (1 mile northwest of Sand Dune Spring), and Green Spring (northwest of Knob Spring). The locations of these springs are shown in **Figure 2-3**. In 2006, flows from the springs had reduced from a peak of 30,000 gpm in 1996 to 11,300 gpm.

Sand Dune Canal and pond collects the water flowing from the springs, and a pumping system delivers water to irrigation areas, injection wells, an infiltration area, and the TS Ranch Reservoir (**Figure 2-3**). At present, the system has the capacity to pump in excess of 45,000 gpm from the Sand Dune Canal to irrigation, infiltration, or injection areas (BLM 2000a, 2003a). An arsenic treatment plant (**Figure 2-3**) at the end of the Sand Dune Canal is available to remove naturally occurring arsenic from the canal flows prior to infiltration or injection if required (BLM 2000a, 2003a). Operation of the Sand Dune Canal and the recirculation system is regulated by the NDEP under Water Pollution Control Permit #NEV95114 (BLM 2000a, 2003a).

Irrigation in Boulder Valley

Since 1993, BGMI has provided irrigation water to ELLCO property. At present, approximately 10,000 acres on the TS Ranch and the Dean Rhoads' Ranch land have been developed for irrigation. During the irrigation season, which typically extends from April through September, an average of approximately 29,000 gpm (60,000 gpm maximum) of dewatering water has been delivered by BGMI and Newmont operations for irrigation of these lands. The irrigation systems can be supplied from the TS Ranch Reservoir via the Boulder Valley irrigation pipeline or from the Sand Dune Canal. During the irrigation season, water from the Sand Dune



LEGEND

- River, Creek, or Ditch
- Pipeline
- Conveyance Canal
- BVI-3 ◆ Injection Well
- Center Pivot Irrigation
- Canal Crossing
- Watering Pond

Contour Interval = 1,000 Feet

N

0 2.5 5 Miles

Source: BLM 2000a.

Betze Pit Expansion Project

Figure 2-3

Water Management Facilities

Canal is delivered to and consumed at the irrigation areas. If irrigation demand exceeds flow from the Sand Dune Canal, additional water can be delivered from the TS Ranch Reservoir to the irrigation areas (BLM 2000a, 2003a).

Infiltration

An outcrop of rhyolite in upper Boulder Valley (**Figure 2-3**) is currently used as a 6-acre Rapid Infiltration Basin (RIB) that has an infiltration capacity of approximately 15,000 gpm. The RIB is used primarily during the non-irrigation season. Infiltration of water from the TS Ranch Reservoir or the Sand Dune Canal is subject to Water Pollution Control Permits #NEV89068 and #NEV95114 issued by the NDEP (BLM 2000a, 2003a).

Injection

BGMI has five injection wells (**Figure 2-3**) authorized under an NDEP underground injection control permit (#NEV93209) to inject water from BGMI's groundwater pumping operations into the rhyolite in the upper Boulder Valley. BGMI estimates the capacity of the five existing injection wells at approximately 28,000 gpm (BLM 2000a, 2003a). Currently BGMI is not actively using these injection wells.

Sand Dune Drainage Embankments

Three temporary embankments were constructed across the Sand Dune drainage downgradient of the Sand Dune Canal. The managed drainages have been mostly dry except for brief periods related to rain or snowmelt events (BLM 2000a, 2003a).

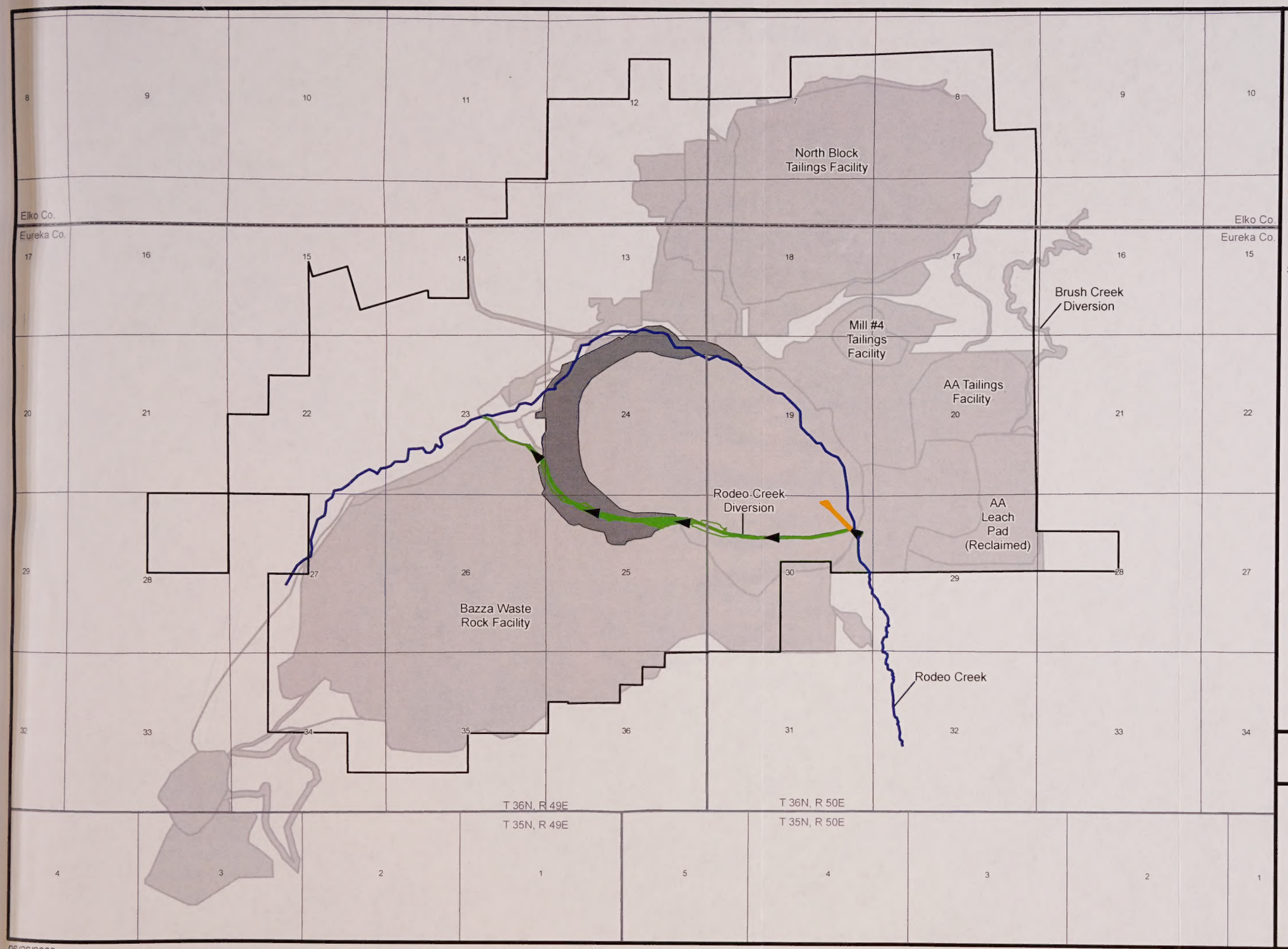
Humboldt River Discharge Authorization

BGMI is authorized to discharge up to 70,000 gpm to the Humboldt River via Boulder Creek, the White House Ditch, and Rock Creek or upland canals and pipelines through an NDEP-issued National Pollutant Discharge Elimination System permit (NV0022675). The system includes a water treatment facility and a water conveyance system composed of buried pipelines, and a synthetically lined upland canal from the treatment plant to an outfall at the Humboldt River (**Figure 2-3**). The water treatment facility is designed to lower the naturally occurring levels of total dissolved solids, fluoride, and boron in the groundwater to levels that are below the Humboldt River water quality standards including temperature. Mine dewatering discharges to the Humboldt River occurred for a 16-month period from September 1997 to early February 1999. Since that time, BGMI has not discharged to the Humboldt River. Currently, BGMI anticipates that use of infiltration and irrigation would be sufficient to manage its dewatering flows without the need for discharge to the Humboldt River. BGMI currently is not operating the water treatment plant or discharging to the Humboldt River; however, BGMI maintains the permit and the facilities.

Rodeo Creek Diversion

Expansion of the Betze Pit under current authorizations would require the relocation of Rodeo Creek from its existing alignment north of the pit to a new alignment south of the pit. BGMI would divert Rodeo Creek along the south wall of the Betze Pit, returning the diverted flow to the original stream channel downstream of the pit (**Figure 2-4**). The diversion would be 12,270 feet in length, 100 feet wide (channel and adjoining access road for channel maintenance), with a total disturbance of 28 acres. All of the disturbance would be on disturbed land owned by BGMI. The USACE has determined that there are no jurisdictional waters in the area (USACE 2006).

BGMI believes that terminating Rodeo Creek into the Betze Pit at the end of mining is the best choice for the long-term management of Rodeo Creek. The potential diversion of Rodeo Creek into the Betze Pit at the end of mining is a closure option. To that end, BGMI will apply for the necessary permits from the State of Nevada at the time of mine closure. If such a permit is not granted, Rodeo Creek would remain as a diversion on the south side of the pit, entirely on privately held lands. In either case, no permit from the BLM is necessary.



LEGEND

- Goldstrike Mine Operations Boundary
- Previous Disturbance
- Authorized Pit Layback Disturbance
- Current Rodeo Creek Alignment
- Rodeo Creek Diversion South of Betze Pit (Planned for Completion in 2009)
- Rodeo Creek Diversion into the Betze Pit (Closure Option)
- Stream Flow Direction

Source: BGMI 2007a, USGS no date.

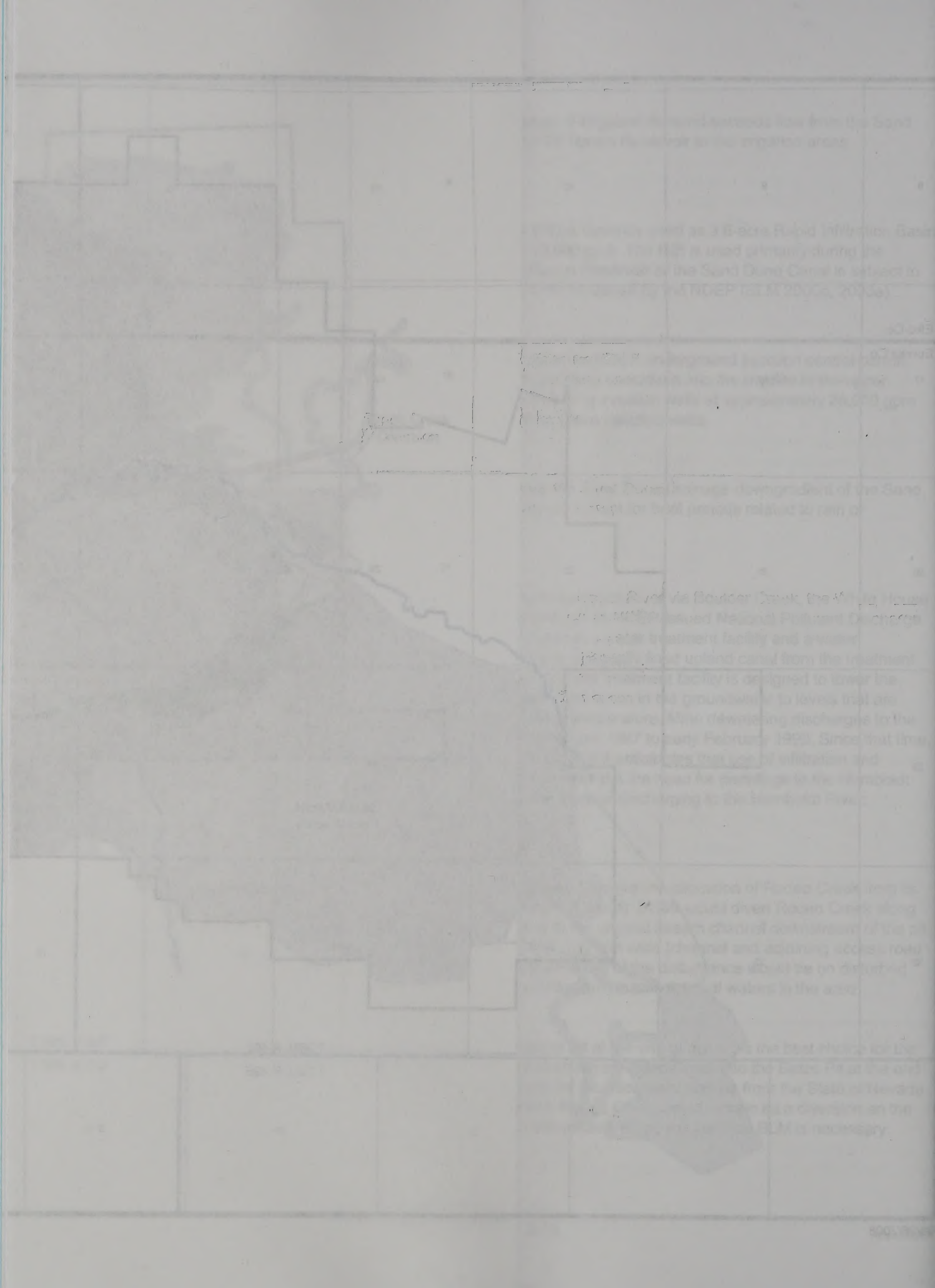
N
W E
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Betze Pit Expansion Project

Figure 2-4

Rodeo Creek Diversions



The planned diversion would consist of a channel bottom approximately 12 feet deep and 20 feet wide with 2 horizontal (H): 1 vertical (V) sideslopes. A portion of the diversion likely would be constructed in mine backfill. The channel would be constructed with two liner systems: one buried liner to prevent channel leakage from recharging the mine backfill and a second surface liner to prevent erosion of the channel and the drop structures. The channel is designed to pass the peak flow (1,700 cubic feet per second [cfs]) due to the 100-year 24-hour storm event occurring in the Rodeo Creek and Brush Creek basins. The Rodeo Creek Diversion is expected to be completed in 2009.

2.2.1.13 Applicant-committed Environmental Protection Measures

The applicant-committed environmental protection measures for the No Action Alternative are identified in the Betze Project EIS (BLM 1991a,b) and SEIS (BLM 2000a, 2003a). Monitoring and mitigation measures for the specific projects are identified in the associated RODs (BLM 1991c, 2003b). These measures would continue to be implemented throughout the life of the approved operations and may include berms, culverts diversion ditches, silt fencing, weed-free straw bales, and other widely accepted sediment control features. Best Management Practices (BMPs) implemented at the Goldstrike Mine are summarized in the Storm Water Pollution Prevention Plan (SWPPP) (JBR 2003; BGMI 2007d) and reclamation plan and include, but are not limited to, the following:

- Surface disturbances kept to a minimum;
- Growth media salvage;
- Reclamation and revegetation of disturbed areas as soon as possible;
- Reclamation monitoring and reseeding if necessary;
- Hay bale and silt fence sediment barrier installations where appropriate;
- Proper design and construction of drainage and diversion channels;
- Bank stabilization using rip-rap;
- Culverts with rip-rapped inlet and outlet;
- Sediment basins and check dams as appropriate;
- Good housekeeping practices in all management areas;
- Inspection of BMP structures after significant runoff events and implementation of repairs if substantial erosion or soil runoff observed; and
- Signage to alert maintenance personnel of inlet structures of retention and detention basins to keep inlets functional.

BGMI established three trust funds as part of mitigation in connection with the 1991 Betze Project EIS and ROD. These trust funds were created to mitigate impacts and provide long-term funding for monitoring of project facilities. A summary description of the three trust funds follows.

- Wetland Mitigation Fund – A $660,000 fund was established for the protection or enhancement of replacement riparian and wetland areas potentially affected by dewatering from the original Betze Project. It includes funding for monitoring of seeps and springs and riparian and wetland areas potentially affected by dewatering based on the maximum projected acreage of impact, 330 acres. The updated dewatering analysis of impacts from the Betze Project SEIS (BLM 2000a, 2003a) predicted that only 150 acres of seeps and springs and riparian and wetland areas potentially would be affected. Monitoring would be continued until at least 2030, and thereafter if determined necessary by the BLM. Monitoring after 2030 would be funded by the Long-term Monitoring Program. The Wetland Mitigation Fund was approximately $480,000 as of September 30, 2007.

The following projects have been funded in part or in total by the Wetland Mitigation Fund:

  - Culvert removal and replacement in the Maggie Creek Basin – Impassible culverts on Beaver Creek and the mainstem of Maggie Creek were replaced with structures suitable for fish passage in 2005.
  - Maggie Creek Land Exchange – Approximately 6,000 acres of historic Lahontan cutthroat trout (LCT) habitat along Susie Creek were acquired in 2004 as a result of the Maggie Creek Land Exchange.
  - Squaw Valley/Spanish Ranch Division Fence – The division fence between the Squaw Valley and Spanish Ranch allotments was completed in 2007 to provide control and management of livestock on LCT streams in the Squaw Valley Allotment.
  - Dixie Creek Fish Barrier – Survey, design, and permitting have been completed for the proposed fish barrier to be constructed in 2008.

- Long-term Monitoring Fund – A $250,000 fund was established for long-term monitoring of potential environmental consequences of the Goldstrike Mine by providing costs for conducting monitoring after 2030. BGMI contributed an additional $300,000 to the fund as part of the mitigation for the Betze Project SEIS (BLM 2003a) to ensure adequate funding for long-term monitoring. This fund was approximately $900,000 as of September 30, 2007.
- Long-term Monitoring and Mitigation Fund – A total of $1,000,000 was established by BGMI to fund the review, monitoring, and mitigation of unanticipated impacts not specifically identified in the EIS reclamation plan, or bond (BLM 1991b). This fund has accrued interest and was approximately $2,200,000 as of September 30, 2007.

The Betze Project SEIS and ROD (BLM 2003a,b) included additional mitigation for impacts due to dewatering operations. A summary description follows.

- Upper Willow Creek Habitat Enhancement Plan (UWCHEP) – The plan was developed to improve aquatic and riparian habitats while providing mitigation for environmental impacts analyzed in the Betze Project SEIS (BLM 2003a). The Proposed Action encompasses approximately 12,300 acres upstream of Willow Creek Reservoir and includes Upper Willow, Lewis, and Nelson creeks. The plan provides for habitat protection and restoration of 20.5 miles of LCT habitat and 635 acres of riparian habitat in the headwaters of upper Willow Creek. The uplands within the enhancement area include a variety of habitats for avian and terrestrial wildlife species, including sage-grouse and mule deer. The plan includes grazing management prescriptions, and stream, riparian, and uplands monitoring within the Proposed Action.
- Conveyance of 1.5-cfs instream flow right in Rock Creek to NDOW and BLM.
- Improvement of 15 springs in cooperation with BLM and NDOW.
- Additional funding for sage-grouse habitat improvement, for research on springsnail relocation techniques, and for biota monitoring in the Humboldt River.

2.2.2 Operations that may be Affected by the Proposed Action

Currently authorized Goldstrike Mine operations, facilities, or activities that may be affected by the proposed project are described in this section and are summarized below:

- Schedule and work force;
- Mining of the Betze Pit;
- In-pit and out-of-pit waste rock facilities;

- Ore processing facilities; and
- Tailings facilities.

2.2.2.1 Schedule and Work Force

Approximately 1,600 workers currently are employed by BGMI for open-pit and underground mining, processing, and reclamation activities at the existing Goldstrike Mine, with operations anticipated to continue through 2011 for the Betze Pit and through 2016 for the Meikle and Rodeo underground mines. BGMI also employs approximately 200 contractors on-site. Work is performed 24 hours a day, 7 days a week at the mine. Ongoing ore processing of ore stockpile reserves would continue for an additional 15 years (through 2026) after mining ceases. Decommissioning and final reclamation also would require a reduced work force until final closure of the mine.

2.2.2.2 Mining Operations and Existing Facilities

BGMI is presently mining the Betze open-pit mine, as well as the Meikle and Rodeo underground mines. Ore produced from the Betze Pit and from the Meikle and Rodeo mines is delivered to BGMI's milling and beneficiation facilities for gold recovery. BGMI's existing mining, milling, and beneficiation facilities are shown in **Figure 2-1**. **Table 2-3** shows the planned ore and waste rock to be mined under current operations (No Action Alternative). The following mining and processing operations would continue under the No Action Alternative.

Betze Pit

The rim of the Betze Pit is at an elevation of approximately 5,200 to 5,300 feet at the northwest edge. The Betze Pit is approximately 1,500 feet deep, 5,600 feet wide, and 10,000 feet long. The depth ranges from a maximum measured below the highest point near the south highwall at approximately 1,800 feet to a minimum beneath the west wall at approximately 1,100 feet. Under the No Action Alternative, typical mining techniques, that will continue unchanged are described in Section 2.2.1, Current Mining Operations or Facilities that will Continue Unchanged. BGMI presently is mining the Betze Pit at an average rate of approximately 420,000 tons of material per day. **Figure 2-4** shows the location of the currently authorized pit expansion under the No Action Alternative.

BGMI's present mine plan projects that mining would continue at the Betze Pit through 2011. Ore and waste volumes to be mined under the approved plans are shown in **Table 2-3**. Under current mining operations, a projected final pit configuration would disturb approximately 1,412 acres. Newmont accesses its Deep Post deposit from a portal at the bottom of the Betze Pit. Newmont's operations in the pit would conclude at the end of 2009.

Waste Rock Facilities

Under the No Action Alternative, waste rock not utilized for construction purposes is disposed of in the Bazza Waste Rock Facility or backfilled into the Betze Pit. The Bazza Waste Rock Facility is located west and southwest of the Betze Pit (**Figure 2-1**). The Bazza Waste Rock Facility has an approximate plan surface area of 2,843 acres and a maximum height of approximately 700 feet above the ground surface. The facility is permitted for 2,843 acres of disturbance (Schafer and Geosystems 2006). As of the end of 2003, approximately 1.58 billion tons of waste rock had been placed in the Bazza facility incorporating a mixture of approximately 25 percent potentially acid generating (PAG) and 75 percent non-PAG waste rock in accordance with the Waste Rock Management Plan (Schafer and Geosystems 2004). Through the end of 2011, approximately 1.93 billion tons of waste rock are anticipated to be placed in the Bazza facility. The remaining 350 million tons of waste rock to be placed in Bazza are expected to be more alkaline than historic waste rock, and only 16 percent of the material is anticipated to be PAG (Schafer and Geosystems 2006).

Since 2003, some of the waste rock produced from the Goldstrike Mine has been used as backfill of part of the eastern portion of the Betze Pit. At the end of mining in 2011, a total of 570 million tons of waste rock would

backfill the pit. Approximately 25 percent of the material to be used as Betze Pit backfill is anticipated to be PAG (Schafer and Geosystems 2006).

Waste rock handling procedures as currently authorized and implemented are outlined in the BGMI Goldstrike Mine Waste Rock Management Plan for the Bazza Waste Rock Facility (Schafer and Geosystems 2004).

As of the end of 2007, approximately 300 acres of the Bazza Waste Rock Facility have been reclaimed. This area includes a portion of the northwest face and the southeast quadrant, adjacent to the un-named drainage and Skarn Hill. This acreage has been re-graded, has had cover and growth media placed as described in the Bazza Waste Rock Management and Permanent Closure plans, and has been seeded with an approved mixture. This acreage is still covered under financial assurance sureties and release from same has not been requested by BGMI from NDEP nor the BLM.

Tailings Facilities

BGMI currently operates two tailings facilities, the North Block Tailings Facility and the AA Tailings Facility (**Figure 2-1**). Under the No Action Alternative, tailings would continue to be placed in the North Block and AA tailings facilities. The North Block tailings impoundment has a downstream constructed embankment with basin seal and geomembrane liner. In addition, the impoundment area has a composite liner system with a low permeability soil liner overlain by a geomembrane liner. The impoundment liner system is covered with a drainage blanket to minimize hydraulic head on the liner. Rotating discharge points promote drying and consolidation of tailings.

The North Block Tailings Facility has a 175-million-ton design capacity, and current storage is 121 million tons. The stage 8 lift is currently in place at the facility, and BGMI has approval from the Nevada Division of Water Resources (NDWR) and NDEP to construct a stage 9 lift. Approximately 36,000 tons per day of tailings are deposited in the North Block Tailings Facility.

The AA Tailings Facility has a downstream constructed embankment with a soil and natural materials liner system, overlain by a drainage blanket. This tailings storage facility was inactive until July 2007. The AA Tailings Facility was reactivated in July 2007 to store additional tailings from ore processing activities. BGMI plans to dispose of an additional 6 million tons of tailings within the AA Tailings Facility by the end of 2008. The total storage capacity of the AA Tailings Facility would be an estimated 10.6 million tons of tailings. Reclamation and closure activities for this facility would begin in 2009.

Betze Pit Backfill

BGMI will place 570 million tons of waste rock from the currently authorized Betze Pit excavation into the pit. The backfill will be located primarily in the eastern and southern portions of the pit and lower portion of the Screamer extension (Schafer and Geochemica 2003).

2.2.3 Existing Mine Reclamation and Site Closure Plans

Under the No Action Alternative, the existing facilities would be reclaimed and closed in accordance with the currently approved reclamation plan, current permits, and applicable federal and state closure and reclamation requirements. Reclamation and final closure of the project site are discussed in the Betze Project EIS (BLM 1991a,b), Meikle Mine EA (BLM 1993), Final Permanent Closure Plan for the Bazza Waste Rock Facility (Schafer and Geosystems 2006), and the Revised Reclamation Plan and 2007 Three-year Update for the Goldstrike Mine Project (BGMI 2007e).

BGMI has 20 years of experience at the Goldstrike Mine in reclamation and closure planning, design, construction, performance monitoring, evaluation, and refinement. Reclamation practices continue to evolve as performance monitoring of past reclamation provides new information that will be used to improve closure design. Elements of the conceptual design include facility regrading and channel design, cover design, and vegetation establishment.

Table 2-3 **Goldstrike Mine Estimated Ore and Waste Rock Annual Totals (in tons) Under the No Action Alternative**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Betze Pit																				
Total Ore Mined	5,967,000	12,826,000	6,242,000	12,094,000	9,635,000															
Total Waste Mined	133,962,000	124,160,000	134,912,000	129,700,000	132,942,000															
Total Mined	139,929,000	136,986,000	141,154,000	141,794,000	142,577,000															
Meikle Underground Mine																				
Total Ore Mined	564,061	602,634	574,502	531,419	522,163	417,088	377,319	313,178	210,463	103,180										
Total Waste Mined	196,705	135,031	151,258	192,251	154,782	94,495	93,801	46,167	47,545	18,438										
Total Mined	760,766	737,665	725,760	723,670	676,945	511,583	471,120	359,345	258,008	121,618										
Rodeo Underground Mine																				
Total Ore Mined	779,138	812,423	682,275	701,809	837,928	842,722	855,347	854,415	855,230	556,289										
Total Waste Mined	73,129	152,251	211,318	106,918	97,616	71,398	101,046	54,471	69,517	54,597										
Total Mined	852,267	964,674	893,593	808,727	935,544	914,120	956,393	908,886	924,747	610,886										
Total Process Throughput																				
Total Ore Processed	11,907,317	12,021,472	5,543,754	5,635,854	5,539,813	5,337,629	5,659,602	5,659,607	5,716,683	5,434,883	5,303,392	5,520,314	5,513,649	6,161,966	5,757,563	6,150,217	4,907,402	3,217,192	3,022,200	1,286,190

Source: BGMI 2007a.

The successful reclamation of the AA Leach Pad was based on BGMI's extensive experience at the Goldstrike Mine, particularly involving the use of Carlin formation material as a growth medium. The AA heap leach facility, a 250-acre run-of-mine (ROM) gold heap leaching facility, was reclaimed in 2000 and 2001. The AA Leach Pad was the first large facility to employ an evapotranspiration (ET) cover that reduces or eliminates infiltration of water and oxygen, and promotes long-term geomorphic stability. An ET cover has a sufficiently fine particle size graduation to reduce permeability and to provide a capillary break between the material on the leach pad and the cover. Its thickness has been optimized to store water during the period of maximum precipitation for elimination by evaporation and transpiration through the period of minimum precipitation (Myers et al. 2001; Zhan et al. 2000).

The AA Leach Pad ET cover system was constructed in 2000 using two cover systems: 4 feet of fine-grained Tertiary-aged valley fill deposits of the Carlin formation and 5 feet of salvaged topsoil materials. In March 2001, the seedbed was prepared and then broadcast seeded with 15.05 pounds per acre of a selected seed mix (perennial grasses, forbs and shrubs, and annual cereal used as a cover crop) and then harrowed to cover the seed. Within 2 years, over 30 percent cover had been achieved indicating good vegetation establishment. By Year 4 of the growing season, Carlin material had a higher cover of desirable perennial grasses and shrubs than topsoil (Zhan et al. 2006).

Results from reclamation monitoring on the AA Leach Pad and other sites have shown that the use of Carlin material as a growth medium allows germination and establishment of a diverse mix of perennial grasses, forbs, and shrubs, especially late-seral species such as bitterbrush (*Purshia tridentata*) and big sagebrush (*Artimesia tridentata*) with only limited annual grass development (Cedar Creek Associates 2007a). **Figures 2-5** and **2-6** show an early stage of reclamation (6 years of growth) on Carlin material on the AA Leach Pad in treatment areas H6 and H7. Four wing saltbush (*Atriplex canescens*) is the dominant shrub species representing 21.4 and 12.0 percent cover for treatment areas H6 and H7, respectively (Cedar Creek Associates 2007a). Four wing saltbush develops and matures quickly and is an early seral species for reclamation at the Goldstrike Mine. Late-seral species like bitterbrush and big sagebrush take more than a decade to mature and are typically found under the canopy of the early seral species like four wing saltbush during the early years of reclamation with Carlin material (Viert 2008). After 10 or more years of reclamation, bitterbrush and big sagebrush eventually replace four wing saltbush (Viert 2008). In contrast, reclamation monitoring over several years has found that bitterbrush and big sagebrush have not established on reclaimed surfaces using topsoil as a growth medium (Cedar Creek Associates 2007a). Reclaimed areas treated with topsoil had higher percent cover of cheatgrass (*Bromus tectorum*) compared with Carlin material (Cedar Creek Associates 2007a). **Figure 2-7** presents reclamation results from 7 years of growth with topsoil at treatment area AR3 on a north slope from the Bazza Waste Rock Facility. Four wing saltbush is the dominant shrub depicted in **Figure 2-7**.

The flux of meteoric water through the AA Leach Pad cover was measured using in-situ vadose zone monitoring. Both covers had very low deep percolation rates, especially after vegetation matured. The mixture of grasses, forbs, and shrubs provides erosion protection and helps maximize evapotranspiration, both important functions of the cover design (Zhan et al. 2006).

The AA Leach Pad reclamation monitoring results were used to optimize the Bazza Waste Rock Facility design (Zhan et al. 2006; Schafer and Geosystems 2006). The Bazza Waste Rock Facility, which will hold about 1.93 billion tons of waste rock within an area of 2,343 acres, will incorporate an ET cover of Carlin material and topsoil to reduce or eliminate infiltration of meteoric water into the Bazza Waste Rock Facility. The facility will be reshaped to resemble surrounding natural landforms prior to cover placement. A series of channels will be integrated into the hillslope morphology to channel surface runoff from the slopes. The channel design approach will utilize the principles of fluvial geomorphology in which channel morphology and grade and bed materials are designed to resemble natural drainage features. The cover will be revegetated with a mixture of native perennial grasses, forbs and shrubs (Schafer and Geosystems 2006; Shafer et al. 2005).

A significant quantity of Carlin Formation material (approximately 87 million tons) will be mined prior to the end of mine life (primarily 2007 to 2011) (Schafer and Geosystems 2006). Readily available Carlin Formation material from the Betze Pit alluvium is an ideal ET cover for leach pads, waste rock facilities, and tailings facilities, depending on particle size, engineering and hydraulic properties, and plant-available water capacity. The ET cover will be designed with Carlin Formation materials or a combination of Carlin and topsoil depending on the performance criteria required.

Approximately 300 acres of the Bazza Waste Rock Facility have already been reclaimed as of the end of 2007. **Figure 2-8** shows vegetation established on recently reclaimed portions of treatment Area AS of the Bazza Waste Rock Facility. Concurrent reclamation of the completed portions of the facility will continue until waste placement in the Bazza Waste Rock Facility ceases and final reclamation begins.

Documentation of the status of interim and final reclamation at the various mine facilities is summarized in the biannual revegetation monitoring reports for the Goldstrike Mine (Cedar Creek Associates 2007a). These reports document when seeding occurred, areas treated, description of facilities, location, the number of acres reclaimed, seeding method, status, when monitoring occurred, and provide a summary of the results.

BGMI received an excellence in mine reclamation award in 2007 from the Nevada Division of Minerals, NDOW, NDEP, BLM, and U.S. Forest Service (USFS) for wildlife habitat enhancement in the closure design of the Bazza Waste Rock Facility. The cover thickness, landform design and vegetative seed mix will combine to create a stable variable landform that will be valuable to local wildlife well into the future. NDOW noted the reclamation success that BGMI has had to date and noted that the seed mixture BGMI was using promoted the establishment and growth of desirable shrub, forb, and grass species on reclamation sites (Lamp 2007a). BGMI also received an excellence in mine reclamation award for the design of the AA Leach Pad in the 1997-1998 timeframe. Post-mining reclamation topography for the No Action Alternative is presented in **Figure 2-9**.

2.2.3.1 Post-mining Land Use and Reclamation Goals

Following closure, the project area would support the multiple land uses of livestock grazing, wildlife habitat, and dispersed recreation. BGMI would work with the agencies and local governments to evaluate alternative land uses that could provide long-term environmental and socioeconomic benefits from the mine infrastructure. All post-closure land uses would conform to applicable Eureka and Elko County requirements.

The objectives of the reclamation program are as follows:

- To provide a stable post-mining landform that supports defined land uses, such as wildlife habitat and domestic grazing;
- To minimize erosion damage and protect water resources through control of water runoff and stabilization of mine facilities;
- To establish post-reclamation surface soil conditions conducive to the regeneration of a stable plant community through salvage, stockpiling and reapplication of soil material;
- To revegetate disturbed areas with a diverse mixture of plant species in order to establish productive long-term plant communities compatible with existing land uses; and
- To maintain public safety by stabilizing or limiting access to landforms that could constitute a public hazard.

2.2.3.2 Growth Media Stockpiling and Use

Suitable growth media (primarily topsoil and Carlin Formation materials) are salvaged during open-pit mining for subsequent use in reclamation. Growth media is placed in stockpiles just outside of the facility footprint or

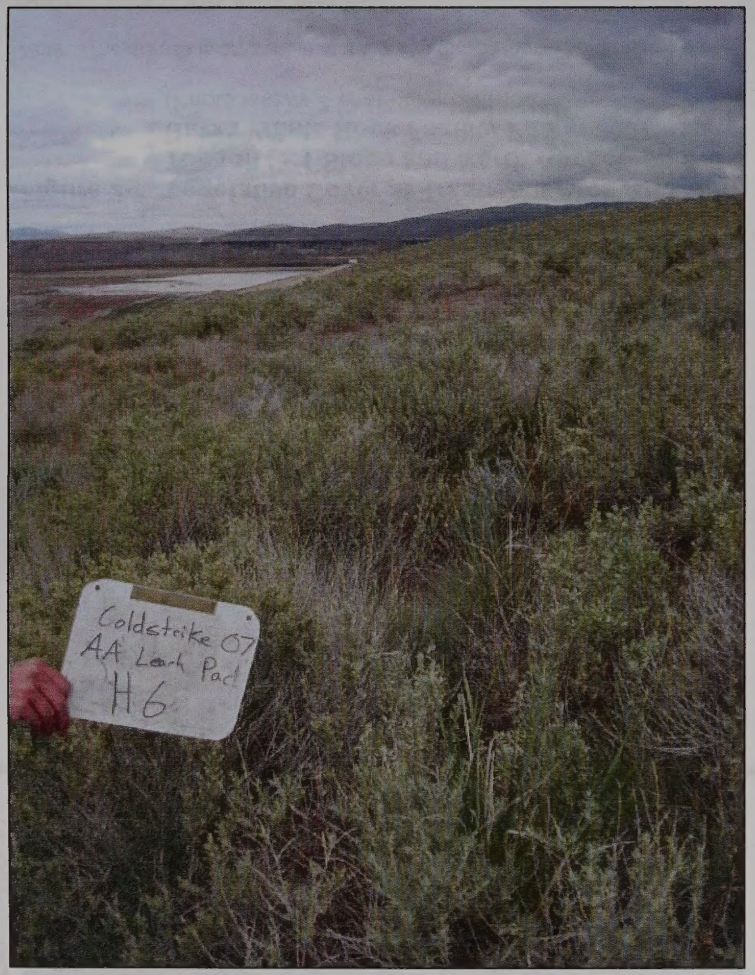


Figure 2-5 Vegetative Cover at Treatment Area H6 with Carlin Material (3:1 Slope and West Aspect) on the AA Leach Pad in 2007.
(Photo shows 6 years of growth)

Source: Cedar Creek Associates 2008.



Figure 2-6 Vegetative Cover at Treatment Area H7 with Carlin Material (3:1 Slope and East Aspect) on the AA Leach Pad in 2007.
(Photo shows 6 years of growth)

Source: Cedar Creek Associates 2008.



Figure 2-7 Vegetative Cover at Treatment Area AR3 with Topsoil (3:1 Slope and North Aspect) on the Bazza Waste Rock Facility Pad in 2007.
(Photo shows 7 years of growth)

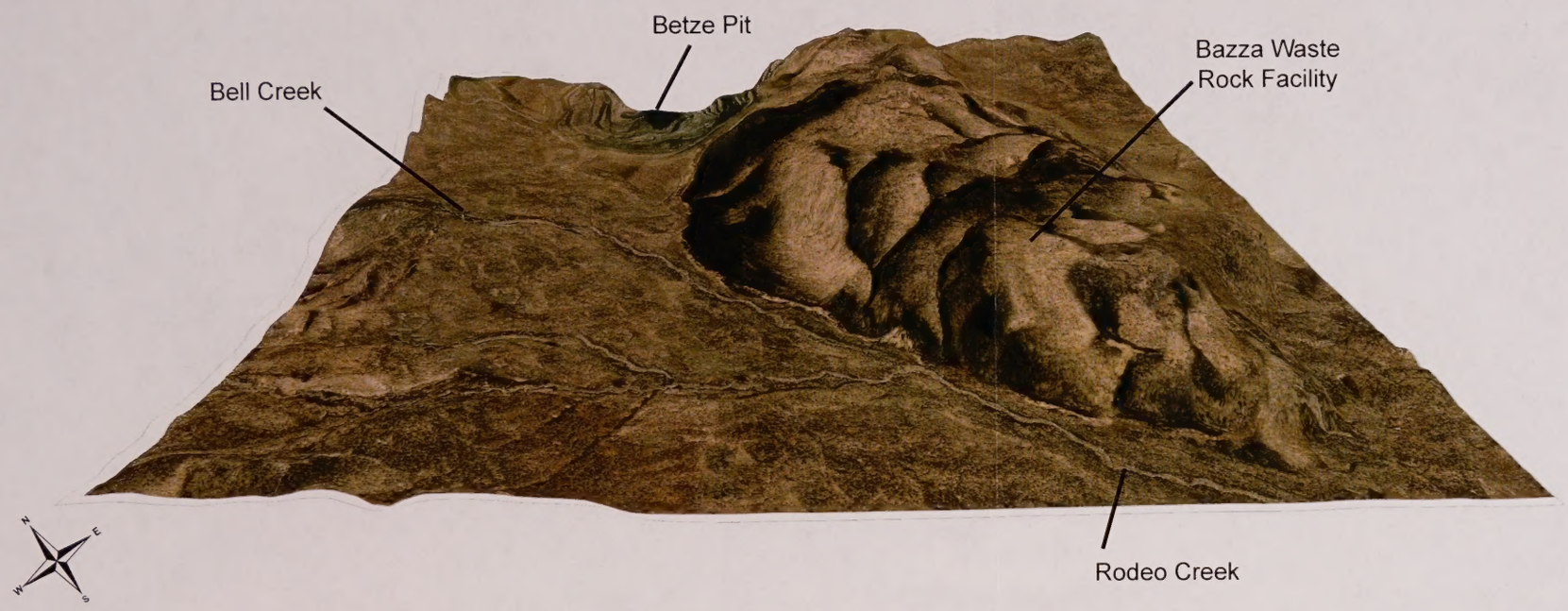
Note: Cheatgrass is present in some areas due to topsoil treatment.

Source: Cedar Creek Associates 2008.



Figure 2-8 Vegetative Cover at Treatment Area AS with Carlin Material (2.5:1 Slope and West Aspect) on the Bazza Waste Rock Facility in 2004.
(Photo shows 4 years of growth)

Source: Cedar Creek Associates 2008.





Source: BGMI 2008a.

Betze Pit Expansion Project

Figure 2-9

No Action Alternative
Post-mining Reclamation
Topography

within the proposed disturbance area (i.e., ancillary disturbance area or completed portions of the waste rock facility) but located such that mining operations would not disturb them. To minimize wind and water erosion, the stockpiles are recontoured to slopes of 2.5H:1V and seeded with an interim seed mix (**Table 2-4**). Diversion channels and/or berms will be constructed around the stockpiles, as needed, to prevent erosion from overland runoff. In addition to direct reclamation, BMPs such as silt fences or straw bales will be used as necessary to contain sediment potentially liberated from direct precipitation. Alternately, the growth media is transported to, and redistributed on, mine-related surface disturbance areas undergoing concurrent reclamation (e.g., waste rock disposal facility). The salvaged soil has been used to construct berm stockpiles at the toe of the waste rock facility, thereby preventing waste rock from scattering downhill during placement. Following final regrading of the waste rock, the growth media berm will be hauled up onto the reshaped waste rock facility for spreading.

Table 2-4 Interim Reclamation Seed Mix

Common Name	Scientific Name	Application Rate (pounds pure live seed [PLS] per acre)
Crested Wheat Grass	*Agropyron cristatum*	12.0
Total Application Rate		**12.0**

Source: BGMI 2007a.

BGMI has been concurrently reclaiming waste rock facilities, tailing dams, leach pads, and topsoil stockpiles since 1987. Areas reclaimed are described in the Monitoring of Revegetation Efforts reports produced every 2 years by Cedar Creek Associates Inc. of Fort Collins, Colorado. BGMI's experience has shown the Carlin material to be superior to topsoil for the mine's reclamation needs. This material contains less nitrogen and does not harbor annual grass seed like topsoil. Topsoil can be placed at a horizon beneath the Carlin material, resulting in a growth medium with reduced invasive grass and weed species allowing a more desirable diverse plant community to establish.

The growth media replacement depth for the mine facilities (with the exception of the open pit) is a minimum of 12 inches based on reclamation experience at the Goldstrike Mine in accordance with the Revised Reclamation Plan and 2007 Three-year Update for the Goldstrike Mine Project (BGMI 2007e).

2.2.3.3 Seed Mixes

Prior to seeding, disturbance areas will be recontoured, surfaces will be ripped or scarified (where conditions warrant), and growth media will be redistributed. Where possible, seedbed preparation will be performed immediately prior to seeding to allow seed placement prior to soil recompaction. Seedbed preparation will consist of scarification. Seed will be applied with either a rangeland drill or with a mechanical broadcaster and harrow, depending upon accessibility. Seedbed preparation and seeding will take place in the fall after grading and topsoiling of reclaimed areas.

A reclamation seed mixture and application rate based on reclamation experience at the Goldstrike Mine and agency requirements are shown in **Table 2-5**. This mixture (or another suitable mix that is approved) would provide forage and cover species similar to the pre-disturbance conditions, facilitating the post-mining land uses of livestock grazing and wildlife habitat. In addition, the seed mix will be determined based on the species' effectiveness in providing erosion protection, the ability to grow within the constraints of the low annual precipitation experienced in the region, its suitability for site aspect, and the elevation and soil type. This seed mix and application rates are based on prior results and monitoring of reclaimed areas and test plots completed at the Goldstrike Mine.

Table 2-5 Reclamation Seed Mix

Common Name	Scientific Name	Species Number of Seeds/lb	Species Percent in Mix	Application Rate lbs. PLS/acre
Grasses				
Ephraim crested wheatgrass	*Agropyron cristatum* var. *ephraim*	200,000	4.5	0.5
Thickspike wheatgrass	*Agropyron dasystrachyum*	154,000	4.5	0.5
Bluebunch wheatgrass	*Agropyron spicatum*	117,000	31.8	3.5
Great Basin wildrye	*Elymus cinereus*	95,000	22.7	2.5
Big bluegrass	*Poa ampla*	917,000	2.3	0.25
Indian ricegrass	*Oryzopsis hymenoides*	188,000	4.5	0.5
Sandberg bluegrass	*Poa secunda*	925,000	2.3	0.25
Forbs				
Blue flax	*Linum lewisii*	293,000	2.3	0.25
Small burnet	*Sanguisorba minor*	55,000	4.4	0.5
Forage kochia	*Kochia prostrata* var. *immigrant*	407,700	0.9	0.1
Palmer penstemon	*Penstemon palmeri*	610,000	0.9	0.1
Shrubs				
Four-winged saltbush	*Atriplex canescens*	52,000	6.8	0.75
Antelope bitterbrush	*Purshia tridentate*	15,000	9.1	1
Winterfat	*Eurotia lanata*	111,000	2.3	0.25
Wyoming big sagebrush	*Artemesia tridentata wyomingensis*	2,500,000	0.5	0.05
Total				**10.8**

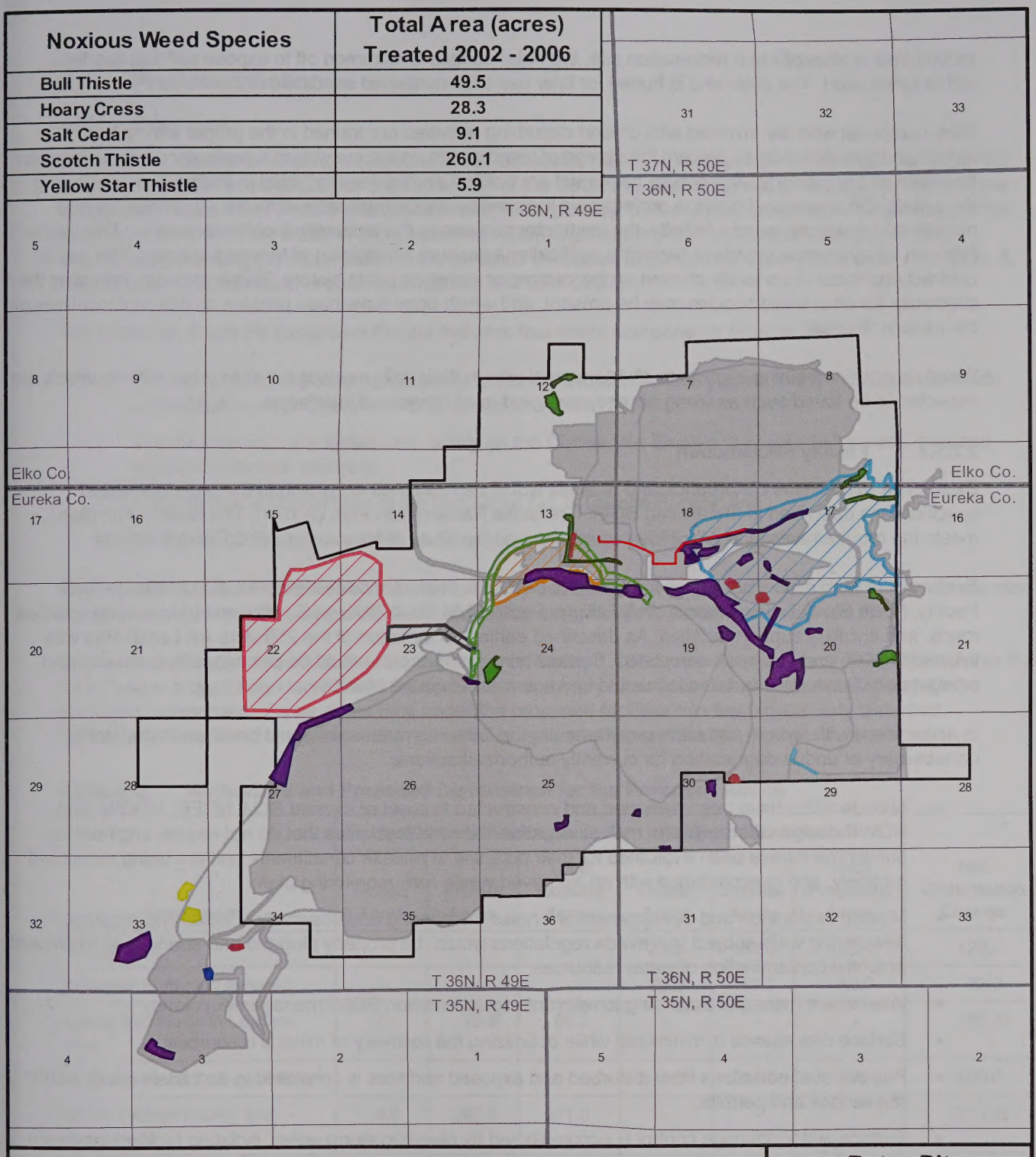
Source: BGMI 2007a.

2.2.3.4 Noxious Weed Management

BGMI has developed and implemented a noxious weed monitoring and control program for the Goldstrike Mine. The results of the annual monitoring program are used to update the plan and develop annual treatment programs. **Figure 2-10** presents noxious weed locations and species present. Noxious weeds shown were treated with appropriate herbicides from 2002 to 2006.

Weeds are actively monitored and managed on the Goldstrike property using prevention, training, monitoring, and eradication techniques. Disturbed ground is kept to a minimum to discourage weeds from establishing. Topsoil is handled in a manner that prevents weed seeds from being spread, and topsoil stockpiles and other growth media piles are seeded with nurse crops designed to out-compete weed species. When topsoil is

Noxious Weed Species	Total Area (acres) Treated 2002 - 2006
Bull Thistle	49.5
Hoary Cress	28.3
Salt Cedar	9.1
Scotch Thistle	260.1
Yellow Star Thistle	5.9



LEGEND

- Goldstrike Mine Operations Boundary
- Bull Thistle
- Hoary Cress
- Salt Cedar
- Scotch Thistle
- Scotch and Bull Thistle
- Yellow Star and Scotch Thistle
- Tailings Facility
- Pit Expansion
- Perimeter Buffer to Laybacks
- Waste Rock Facility
- Clydesdale Haul Road
- Previous Disturbance
- Tailings Pipelines

N

0 0.25 0.5 1 Miles

Source: BGMI 2008b.

Betze Pit Expansion Project

Figure 2-10

Noxious Weed Treatment Areas on Barrick Goldstrike Mine Site

06/26/2008

moved from a stockpile to a reclamation site, the outer surface is skimmed off to expose soil that has less viable weed seed. The outer rind is buried for later use after contained seeds die off.

Mine personnel who are involved with ground-disturbing activities are trained in the proper way to handle topsoil and growth media to prevent the spread of weed seeds. In the event that a particular noxious weed is identified on the property, appropriate personnel are notified and advised to assist in finding and eradicating the weeds. On a seasonal basis, a professional licensed herbicide applicator visits the Goldstrike Mine to monitor and eradicate weeds. Initially, the contractor canvasses the entire site looking for weeds. This visit is followed up by several rounds of herbicide application to ensure eradication of targeted species. The same contract applicator is generally chosen so the contractor develops a site history. This knowledge prepares the contractor for what weed species may be present, and which ones have been present on different locations of the mine in the past.

Weed recognition training is given to site personnel who in their daily routines travel to areas where weeds are expected to be found such as along access roads and mine rangeland interfaces.

2.2.3.5 Facility Reclamation

Existing permitted mine disturbance and facilities would be reclaimed according to the procedures and specifications described in the revised BGMI Goldstrike Reclamation Plan (2007e). The reclamation plan meets the requirements of BLM's 3809 regulations and the State of Nevada's NRS 519A regulations.

Existing permitted mine disturbance includes the Betze Pit, Rodeo and Meikle mines, Bazza Waste Rock Facility, North Block Tailings Facility, AA Tailings Facility, Mill No. 4 Tailings Facility, mine processing facilities, roads, and ancillary support facilities. As described earlier, reclamation of the 250-acre AA Leach Pad was initiated in 2000 and has been completed. Surface mine components would be permanently reclaimed and revegetated. Concurrent reclamation would be implemented where feasible.

In accordance with federal and state requirements, the following measures would be taken to prevent unnecessary or undue degradation for currently authorized actions:

- Mine facilities have been designed and constructed to meet or exceed BLM, NDEP, NDOW, and NDWR design criteria. Waste rock storage facilities and stockpiles that do not require engineered containment have been evaluated for their potential to release constituents and are being monitored routinely, and in accordance with an approved waste rock monitoring plan;
- Mineral exploration and development drill holes, monitoring and observation wells, and production dewatering wells subject to Nevada regulations would be properly plugged and abandoned to prevent potential contamination of water resources;
- Wastes are managed according to relevant regulations and BGMI management plans;
- Surface disturbance is minimized while optimizing the recovery of mineral resources;
- Fugitive dust emissions from disturbed and exposed surfaces is controlled in accordance with NDEP regulations and permits;
- Surface water drainage control is accomplished by diverting storm water, isolating facility runoff, and minimizing erosion; and
- Where suitable as a growth media, surface soils and some alluvial material in the open pit are managed as a growth media resource and removed, stockpiled, and would be used during reclamation.

The reclamation plan (BGMI 2007e) addresses earthwork and recontouring, revegetation and stabilization, chemical stabilization and disposal, and monitoring operations necessary to successfully reclaim the existing and authorized disturbance.

2.3 Proposed Action

2.3.1 Overview

BGMI would expand its existing operations at the Goldstrike Mine. An Amendment to the POO (NVN-70708) and Reclamation Permit (0026) for the Expansion of the Betze Pit, Goldstrike No. 3 Tailings Facility, and the Clydesdale Waste Rock Facility (the Amendment) for expansion of the Goldstrike Mine was submitted to the BLM in January 2007 by BGMI in compliance with BLM regulations (43 CFR Subpart 3809) and NDEP regulations governing the reclamation of mined lands (Nevada Administrative Code [NAC] 519A.010-635). A revised plan was submitted in June 2007 (BGMI and SRK 2007).

The proposed Betze Pit Expansion Project includes four major components (**Figure 2-11**):

- An expansion of the existing Betze Pit to include two additional laybacks to the north and west with associated in-pit and perimeter haul roads and buffer;
- The construction of a waste rock facility on the Clydesdale Block and associated access road and ephemeral stream crossing;
- Construction and operation of the Goldstrike No. 3 Tailings Facility; and
- An extension of surface mining and surface mining employment for 4 years.

The Proposed Action would extend the roaster facility use by up to 5 years and would allow for the accelerated reclamation of the existing Bazza Waste Rock Facility using Carlin material from the Betze Pit.

The proposed project would result in a total of approximately 1,180 acres of new surface disturbance within the 10,370-acre project boundary. **Table 2-6** presents a summary of surface disturbance associated with the proposed amendment. Some of the land under the proposed facilities has been previously disturbed. **Table 2-6** shows the change of use from one category to another and the net change in disturbance.

Table 2-6 Authorized and Proposed Disturbance for the Proposed Action

Component	Authorized Disturbance			Proposed Disturbance			Net Disturbance Change
	Public Acres	Private Acres	Total Existing Acres	Public Acres	Private Acres	Total Proposed Acres	
Pit Laybacks	-	-	-	23.0	103.0	126.0	126.0
Perimeter Buffer to Laybacks	-	-	-	26.5	62.5	89.0	89.0
Roads/Well Fields in Layback Area	7.1	79.2	86.3	-	-	-	(86.3)
Goldstrike No. 3 Tailings Facility[1]		-	-	46.0	644.0	690.0	690.0
Mill #4 Tailings Facility and Disturbance	9.0	202.0	211.0	-	-	-	(211.0)
Clydesdale Waste Rock Facility	-	-	-	400.0	135.0	535.0	535.0
Clydesdale Haul Road	-	-		14.1	22.7	36.8	36.8
Total[2]	**16**	**281**	**297**	**510**	**967**	**1,477**	**1,180**

[1]Includes approximately 211 acres of existing Mill #4 tailings storage facility and other reclaimed but not released areas previously authorized by BLM and NDEP.

[2]Totals have been rounded to the nearest acre.

Source: BGMI and SRK 2007; BGMI 2008a.

BGMI is currently authorized to disturb 7,882 acres (847 acres of public land and 7,035 acres of private land) within the authorized Goldstrike POO boundary associated with pits, waste rock facilities, heap leach facilities, tailings facilities, process buildings, roads, growth media stockpiles, and ancillary facilities. Roads in the layback area and Mill #4 Tailings Facility disturbances totaling 297 acres are categorized as previously authorized disturbance. Therefore, an additional net 1,180 acres (**Table 2-6**) associated with the Proposed Action would bring the total disturbed acreage to 9,062 acres.

2.3.2 Use and Occupancy of Public Lands

Subpart 3715 of 43 CFR identifies the requirements for use and "occupancy of public lands for the development of locatable mineral deposits by restricting such use or occupancy to that which is reasonably incident." BGMI is required to meet the specific conditions outlined in 43 CFR Subpart 3715.3-2 as the Proposed Action would affect 494 acres of public land managed by the BLM. A programmatic EA for mining claim, millsite use, and occupancy for selected actions was completed by the Nevada State Office of the BLM with a finding of no significant impact (BLM 2000c). The Programmatic EA provides the basis for a Determination of NEPA Adequacy for BGMI's proposed use and occupancy of public lands.

2.3.3 Land Ownership and Mining Claims

The proposed project would occur within the existing Goldstrike Mine operations boundary and would disturb approximately 494 acres (42 percent) of public lands within the POO boundary administered by the BLM Elko District Office and approximately 686 (58 percent) owned by BGMI (**Figure 1-2**). **Table 2-7** presents the legal description of the Proposed Action.

Table 2-7 Legal Description of Proposed Action

Township	Range	Section
36N	49E	13, 14, 15, 22, 23, 24, 25
36N	50E	17, 18, 19, 20

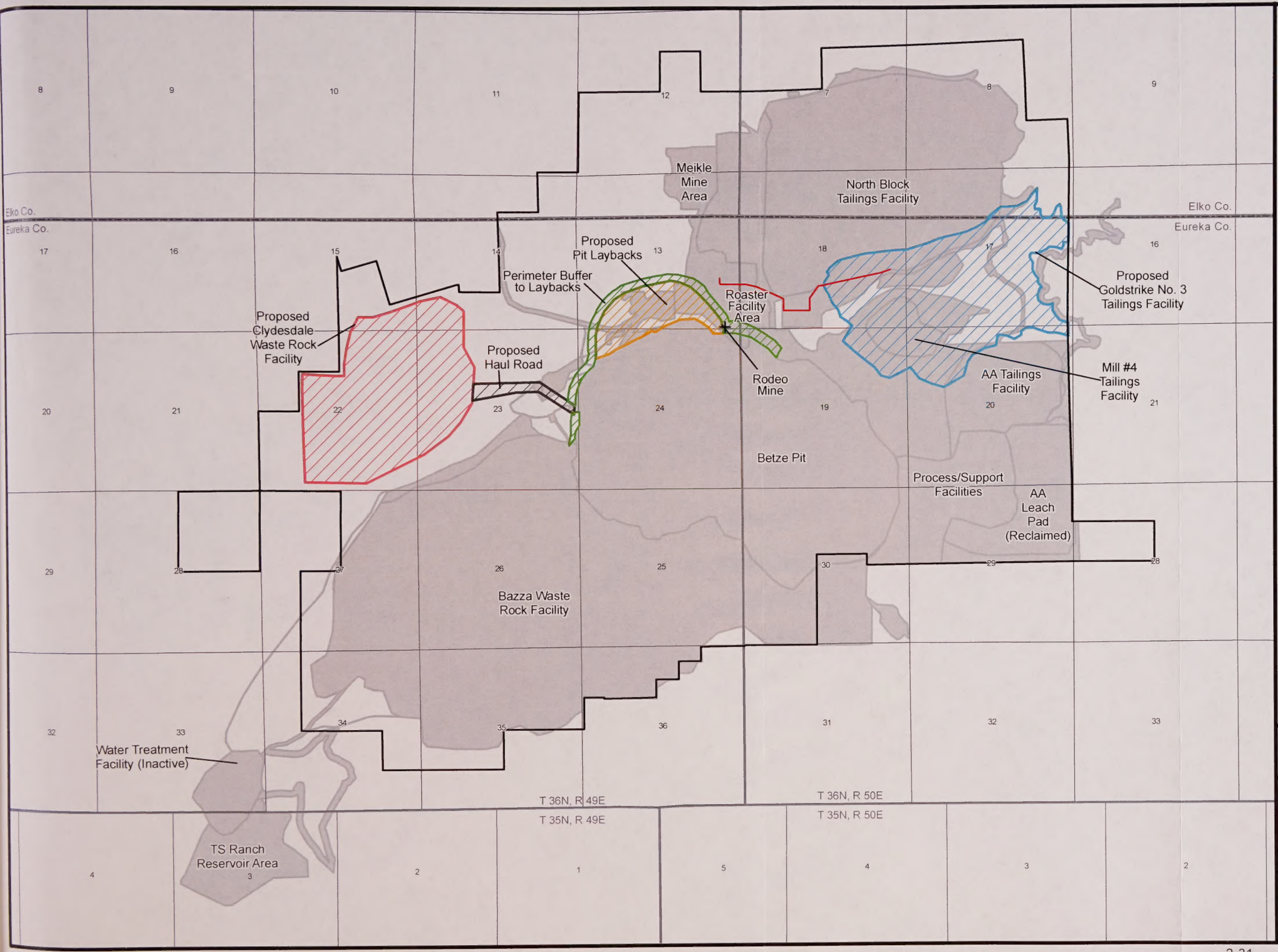
Source: BGMI and SRK 2007.

2.3.4 Schedule and Work Force

Construction and operation of the proposed Betze Pit Expansion Project is anticipated to be initiated in early 2009 pending authorization of required permits and approvals. Construction and operation of the proposed pit expansion would be completed in approximately 4 years. Mining of the second northwest layback would be undertaken in 2012 and would be followed by the third northwest layback in 2013. (Mining of the first northwest layback of the Betze Pit is currently authorized as part of the No Action Alternative.) Mining of the Betze Pit would be completed in approximately 2015. Ore processing from stockpiles would continue through 2031.

Underground mining at Meikle and Rodeo, which are immediately adjacent to the open pit are currently ongoing. This activity will continue through 2016. Manpower for this operation is included in the totals previously discussed.

Construction of the proposed Clydesdale Waste Rock Facility would begin in 2009 and continue through 2015. The Goldstrike No. 3 Tailings Facility would begin operation in 2011 and continue to operate through 2031. Concurrent reclamation would be conducted as areas and facilities become available. Reclamation of the Bazza Waste Rock Facility would be accelerated. Final reclamation and closure would occur 3 to 5 years beyond the useful life of each facility.



LEGEND

- Goldstrike Mine Operations Boundary
- Tailings Facility
- Pit Expansion
- Perimeter Buffer to Laybacks
- Waste Rock Facility
- Clydesdale Haul Road
- Previous Disturbance
- Tailings Pipelines

Source: BGMI and SRK 2007; BGMI 2007a.

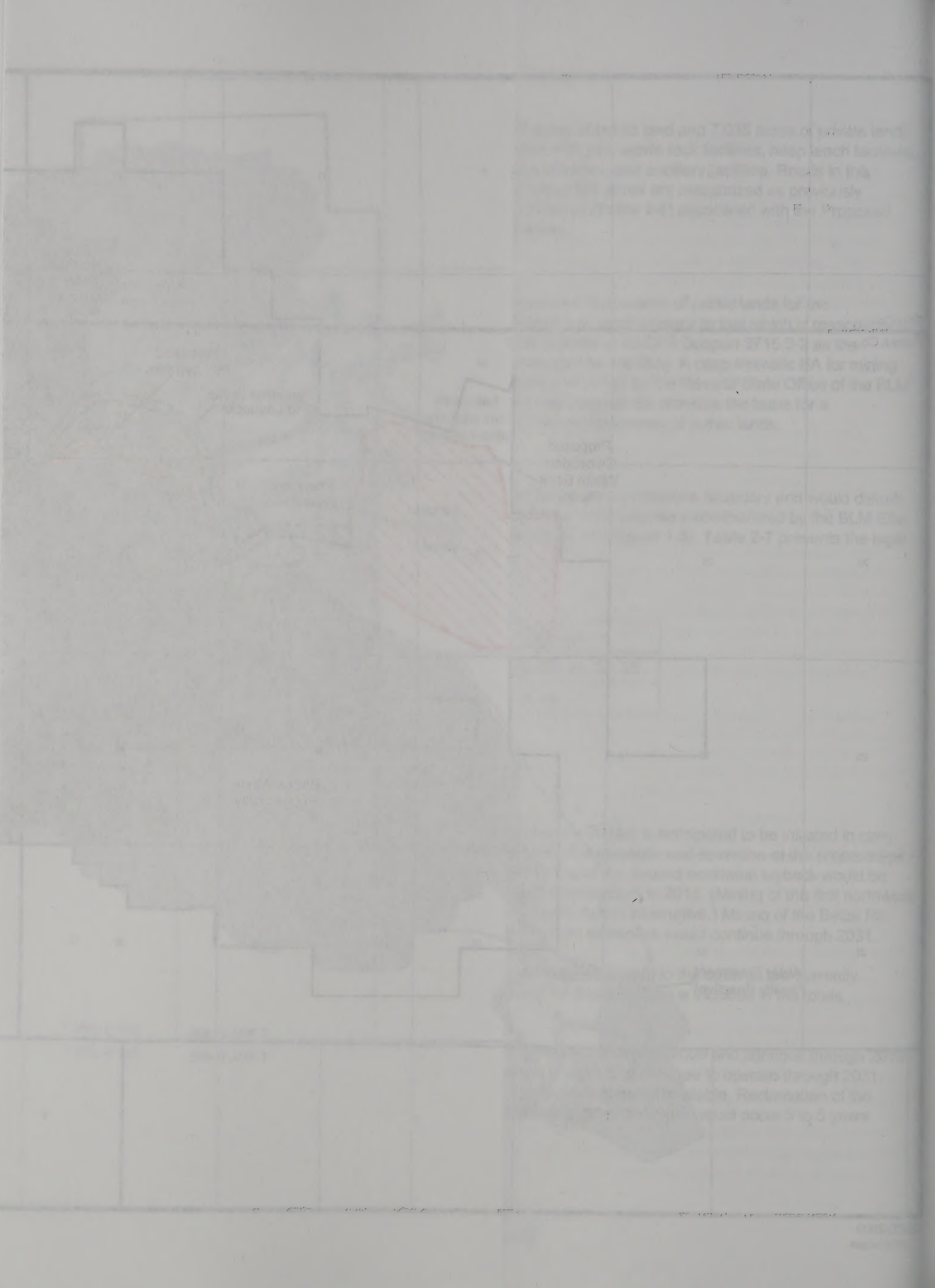
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0 0.5 1 Miles

Betze Pit Expansion Project

Figure 2-11

Proposed Action Facilities



BGMI currently employs 1,600 workers at the existing Goldstrike Mine and approximately 200 contractors. BGMI would utilize the existing work force to complete the proposed project; as a result, no new employees would be hired. It is anticipated that the proposed project would provide employment at the mine through 2015 and at processing facilities through 2031. BGMI may utilize a contract work force to perform pre-stripping operations.

2.3.5 Expansion of Mining Operations

2.3.5.1 Expansion of the Betze Pit

Under the Proposed Action, the existing Betze Pit would be expanded to mine the ore deposit. Two contiguous pit laybacks are proposed: the second northwest and the third northwest. The first northwest layback will be mined under the No Action Alternative. Portions of the second and third northwest laybacks would be on public land and private land as shown in **Figure 1-2**. Approximately 23 acres would be located on public land and 103 acres would be located on private land. A perimeter buffer to the laybacks would include 26.5 acres of public land and 62.5 acres of private land. Existing facilities within the footprint of the proposed layback and buffer include dewatering wells, power distribution, and haul and access roads.

The layback area (**Figure 2-11**) would range in depth from approximately 1,140 feet to 1,260 feet. Crest elevations would range from 5,230 feet to 5,290 feet amsl. Benches would range from 20 to 60 feet in height, consistent with current bench heights. The layback areas would be approximately 4,300 feet long and approximately 1,100 feet wide at their maximum extent. The ultimate pit floor under the Proposed Action final wall layback is projected to be at an elevation of 4,120 feet (BGMI 2007a), which is above the currently authorized pit elevation of 3,600 feet or 3,575 feet amsl.

The design of the Betze Pit Expansion Project has been developed based on the configurations of the ore bodies as defined during exploration drilling, BGMI's experience in similar rock types, the results of geotechnical testing and hydrological studies, and surface mining industry and MSHA standards. Geologic structural mapping and open-pit wall and groundwater level monitoring would be conducted during mining to optimize pit design and ensure pit stability during operations. Slope movement monitoring would be continued to evaluate the safety of open-pit high walls. In addition, operational procedures for controlling blasting and bench scaling would facilitate mining of stable open-pit walls.

The western layback slopes generally exhibit favorable stability due to improved rock mass strengths, structural geology, and advanced depressurization of the rock mass. However, some adverse bedding orientations may require localized areas to have slightly flatter inter-ramp angles, compared to the rest of the layback near the upper ramps.

The removal of ore and waste rock from the proposed pit expansion areas would be accomplished using the same conventional open-pit mining methods (truck and shovel) currently used at the existing Betze Pit, including drilling, blasting, loading, and hauling (Sections 2.2.1.3 and 2.2.1.4). Mining would be conducted 24 hours per day, 7 days per week.

BGMI's waste rock classification system was formulated on the basis of geochemical testing of the ore to determine the balance of acid generation potential (AGP) and acid neutralization potential (ANP) and threshold levels of sulfide sulfur that would represent a risk of acid generation. PAG waste rock was defined as material with a net neutralization potential (NNP), which is the ANP minus the AGP, of less than 0 and a sulfide sulfur value greater than 0.3 percent. "Non-PAG" waste rock is classified as material with NNP greater than 0 or sulfide sulfur less than 0.3 percent (Schafer and Geosystems 2007). More detailed information on waste rock characterization and geochemistry is described in Section 3.3.1.8.

Both PAG and non-PAG waste rock would be removed with the ore and managed pursuant to the Waste Rock Management Plan for the Clydesdale Waste Rock Facility (Schafer and Geosystems Analysis 2007). The majority of the PAG material mined from this expansion would be placed as backfill within the pit under the

projected post-mining water level. Up to 10 percent of the PAG material would be placed in the proposed Clydesdale Waste Rock Facility. Non-PAG material mined from the expansion would be placed in the proposed Clydesdale Waste Rock Facility, in existing storage facilities, in the Betze Pit as backfill, or used to construct the proposed Goldstrike No. 3 Tailings Facility (BGMI and SRK 2007; Schafer 2007). **Table 2-8** presents the anticipated tonnage of material that would be removed from the proposed laybacks.

Table 2-8 Waste Rock, Carlin Material, and Ore Tonnages (millions of tons) to be Mined Under the Proposed Action

	2nd NW Layback	3rd NW Layback	Total
Non-PAG Waste Rock	125.5	185.0	310.5
PAG Waste Rock	2.1	2.4	4.5
Carlin Material	0.5	0	0.5
Ore	5.3	7.1	12.4
Total	**133.4**	**194.0**	**327.9**

Source: BGMI and SRK 2007.

A summary of the total annual ore and waste rock that would be mined from the Betze Pit, Meikle, and Rodeo underground mines is presented in **Table 2-9** and includes ore and waste rock to be mined under the Proposed Action as well as currently authorized ore and waste rock to be mined.

A list of the equipment requirements for the proposed laybacks is provided below in **Table 2-10**. This equipment is presently operating at the pit. BGMI may add to the mobile equipment fleet as part of The Proposed Action.

2.3.5.2 Haul Roads

A haul road would be constructed to provide for the transport of waste rock from the pit to the proposed Clydesdale Waste Rock Facility. The proposed road would be approximately 3,500 feet in length and would have a travel surface of 170 feet in width with a total width of 400 feet. The road would be constructed with safety berms on the outer edges and would be rocked, as needed, to provide for all weather travel. Drainage would be established between the road edge and safety berm.

The haul road would cross the historical drainages, which would not be carrying water since both Brush and Rodeo creeks would be diverted to the south perimeter of the Betze Pit. Corrugated metal pipe culverts would be placed at the Bell Creek crossing. The inlets and outlets for the culverts would be rip-rapped to minimize erosion and damage to the natural stream channel. The culverts would be designed to safely handle flows of a 100-year/24-hour storm event.

2.3.5.3 Waste Rock Facilities

Under the Proposed Action, a new waste rock facility (Clydesdale Waste Rock Facility) would be constructed. Waste rock from the proposed laybacks also would be placed in the existing Bazza Waste Rock Facility or as in-pit backfill.

Clydesdale Waste Rock Facility

The proposed Clydesdale Waste Rock Facility would accommodate up to 350 million tons of waste rock (**Figure 2-12**). To minimize haul distance and surface disturbance, the proposed facility would be constructed within the Clydesdale Block, approximately 3,500 feet west of the Betze Pit, and just west of the current

Table 2-9 Goldstrike Mine Estimated Ore and Waste Rock Annual Totals (in tons) that Include the Proposed Action

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Betze Pit																									
Total Ore Mined	5,967,000	12,826,000	6,242,000	12,094,000	9,635,000	11,669,000	6,923,000	7,656,000	4,197,000																
Total Waste Mined	133,962,000	124,160,000	134,912,000	129,700,000	132,942,000	131,661,000	136,094,000	109,259,000	8,000,000																
Total Mined	139,929,000	136,986,000	141,154,000	141,794,000	142,577,000	143,330,000	143,017,000	116,915,000	12,197,000																
Meikle Underground Mine																									
Total Ore Mined	564,061	602,634	574,502	531,419	522,163	417,088	377,319	313,178	210,463	103,180															
Total Waste Mined	196,705	135,031	151,258	192,251	154,782	94,495	93,801	46,167	47,545	18,438															
Total Mined	760,766	737,665	725,760	723,670	676,945	511,583	471,120	359,345	258,008	121,618															
Rodeo Underground Mine																									
Total Ore Mined	779,138	812,423	682,275	701,809	837,928	842,722	855,347	854,415	855,230	556,289															
Total Waste Mined	73,129	152,251	211,318	106,918	97,616	71,398	101,046	54,471	69,517	54,597															
Total Mined	852,267	964,674	893,593	808,727	935,544	914,120	956,393	908,886	924,747	610,886															
Total Process Throughput																									
Total Ore Processed	11,907,317	12,021,472	5,543,754	5,635,854	5,539,813	5,787,161	5,337,629	5,659,607	5,716,683	5,434,883	5,303,392	5,520,314	5,513,649	6,161,966	5,757,563	6,150,217	4,907,402	3,217,192	3,022,200	3,080,223	3,022,200	3,022,200	3,022,200	3,022,200	3,204,167

Source: BGMI 2007a.

Table 2-10 List of Expected Mine Mobile Equipment

Type of Equipment	Number
Electric shovels (P&H 2800 and 4100 classes)	4
Hydraulic shovel (Hitachi 5500-class)	1
Haul trucks (330-ton)	35 to 40
Rotary blasthole drills	7 to 10
Track bulldozers	5
Rubber-tired bulldozers	5
Graders	6
Water trucks	3

Source: BGMI and SRK 2007.

confluence of Bell and Rodeo creeks. The toe elevation would be approximately 5,150 feet amsl, and the crest elevation would be approximately 5,650 feet amsl for a facility height of approximately 500 feet. Cross-sections and profiles of the proposed facility are presented in **Figure 2-12**. To provide a spatial buffer for Bell and Rodeo creeks, the Clydesdale Waste Rock Facility will be set back at least 100 feet from the uppermost edge of the west creek bank.

The Clydesdale Waste Rock Facility would be engineered, constructed, and reclaimed in the same manner as the currently permitted Bazza Waste Rock Facility to ensure long-term stability and provide for effective reclamation. Mined waste rock would be hauled to the proposed Clydesdale Waste Rock Facility and placed by end dumping from haul trucks from the top of the active dump faces, resulting in working faces at the angle of repose (approximately 1.3H:1V). The bench heights would be in lifts of approximately 100 feet. Where feasible, the Clydesdale Waste Rock Facility would be built as a terraced structure to facilitate recontouring and reclamation. During reclamation, the terraces would be incorporated into the overall reclaimed slope at 2.5H:1V on the north and west slopes and at 2.8H:1V on the south and east slopes.

As required by NDEP, quarterly samples of distinct waste rock units currently are collected from the Betze Pit and subjected to meteoric water mobility and acid base accounting tests. Based on the results, any localized areas of acid-generating waste rock are placed internal to the waste rock disposal facility and encapsulated or blended with acid neutralizing waste rock prior to placement (Schafer and Geosystems 2007). These procedures, as well as specific waste rock handling procedures for the proposed Clydesdale storage facility, also would be implemented for the Betze Pit Expansion Project in accordance with the Waste Rock Management Plan for the Clydesdale Waste Rock Facility (Schafer and Geosystems 2007).

Approximately 310.5 million tons of non-PAG waste rock would be mined from the Betze Pit laybacks (**Table 2-8**). Most (90 percent) of the non-PAG waste rock would be placed in the Clydesdale Waste Rock Facility, or about 280 million tons. The remaining 10 percent (31 million tons) of non-PAG waste rock would go into the pit as backfill. The estimated PAG tonnage to be mined is 4.5 million tons. Ten percent of this would go into the Clydesdale Waste Rock Facility, or 0.45 million tons. Ninety percent of the PAG would go in the pit as backfill, or approximately 4.05 tons. By design, all PAG placed in the pit will be under the ultimate pit water level (BGMI and SRK 2007).

PAG waste rock routed to the proposed Clydesdale Waste Rock Facility would be placed in an encapsulated PAG cell within the facility. The PAG cell would have a minimum 50-foot setback from the base of the facility and would be overlain with a thick cover system. The 6-foot composite cover is designed to eliminate or reduce infiltration of water and oxygen. The non-PAG waste rock cover would consist of a minimum of 12 inches of either topsoil, Carlin material, or combination of materials (Schafer and Geosystems 2007).

To control erosion and for long-term stability of the proposed Clydesdale Waste Rock Facility, appropriate storm water controls would be constructed and the waste rock piles appropriately graded to control storm water runoff and runon. Engineered storm water diversions constructed upgradient of the facility, as needed, would be designed to accommodate flow from a 24-hour, 100-year storm event and would route the flow to the drainages downgradient (Bell, Rodeo, and Boulder creeks) of the facility. During operations, the waste rock facility would be visually monitored following spring snowmelt and intense rain events to ensure that drainage and sediment control measures are effective and operating properly.

This facility will disturb approximately 535 acres of public land but will allow for the accelerated reclamation of approximately 2,524 acres of the Bazza Waste Rock Facility. This accelerated reclamation is facilitated by the ability of the mine to utilize Carlin material that is mined during the early years of the proposed expansion as cover and growth media on the Bazza facility while other waste rock is diverted to the Clydesdale facility.

Betze Pit Backfill

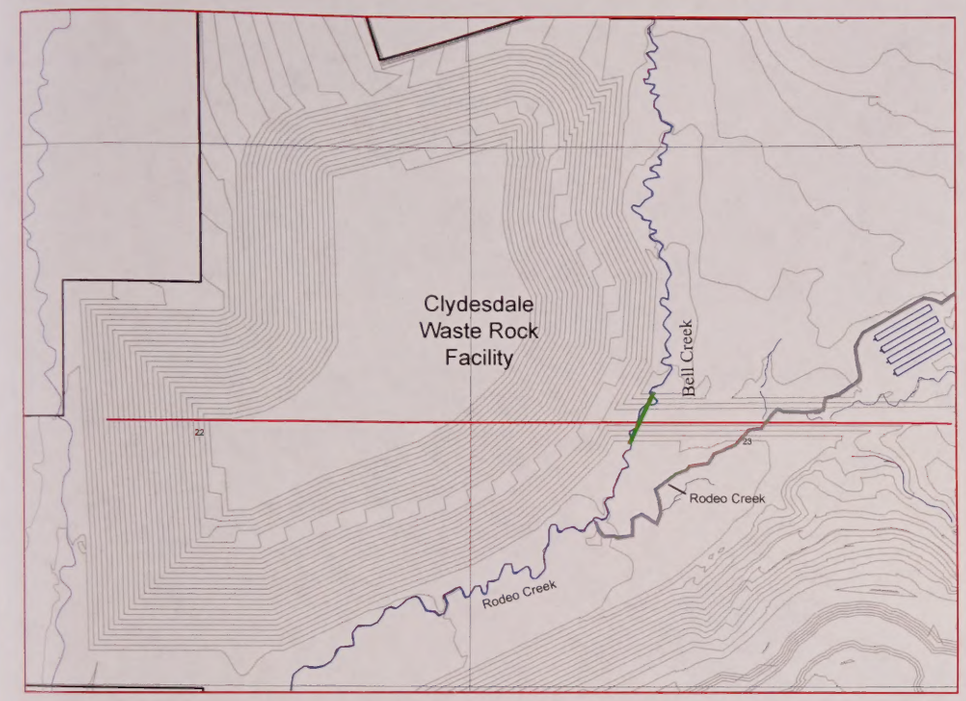
A portion of the waste rock from the Betze Pit will be placed in the existing Betze Pit backfill area (**Figure 2-13**). Three hundred seventy million tons of waste rock are proposed as backfill in addition to the 570 million tons of backfill in the current mine plan (Schafer 2007). Backfill would be placed in three zones including the lower backfill (<5,116 feet), middle backfill (5,116 to 5,246 feet), and upper backfill zone (>5,246 feet). The upper and middle backfill zones will be above water when the pit lake is completely inundated (Schafer 2008a). Section 3.3, Groundwater Resources and Geochemistry, further describes the Betze Pit backfill and pit lake.

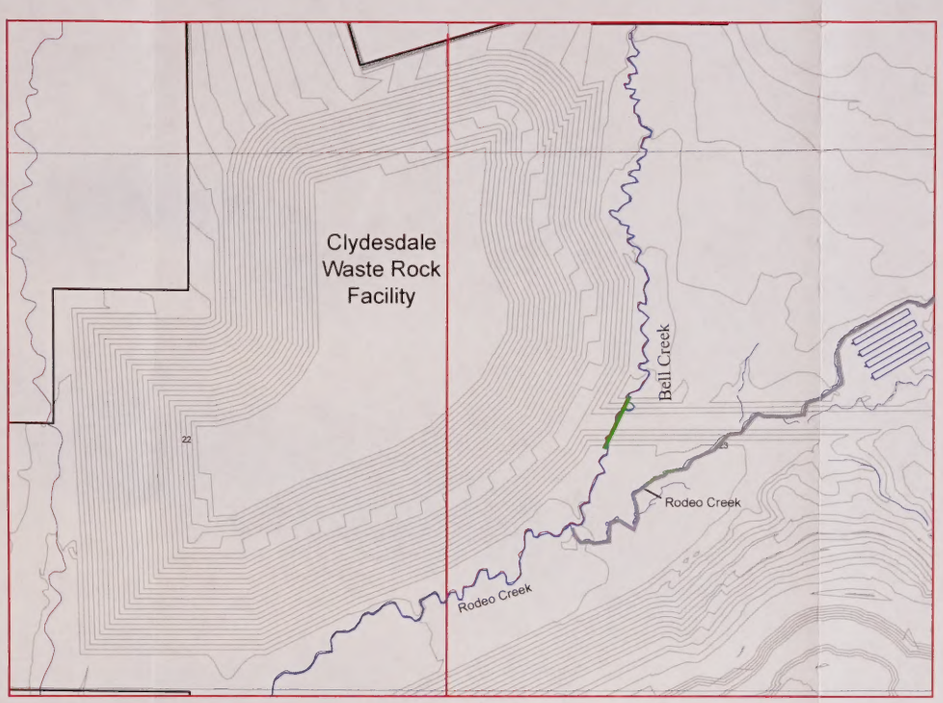
Approximately 4.5 million tons of PAG waste rock would be mined from the proposed Betze Pit laybacks (**Table 2-8**). Most (90 percent or about 4 million tons) of the PAG waste rock would be back-filled into the Betze Pit. PAG material would not be placed in the middle backfill zone. In addition, approximately 10 percent or about 31 million tons of the non-PAG waste rock material would be backfilled into the Betze Pit.

2.3.5.4 Goldstrike No. 3 Tailings Facility

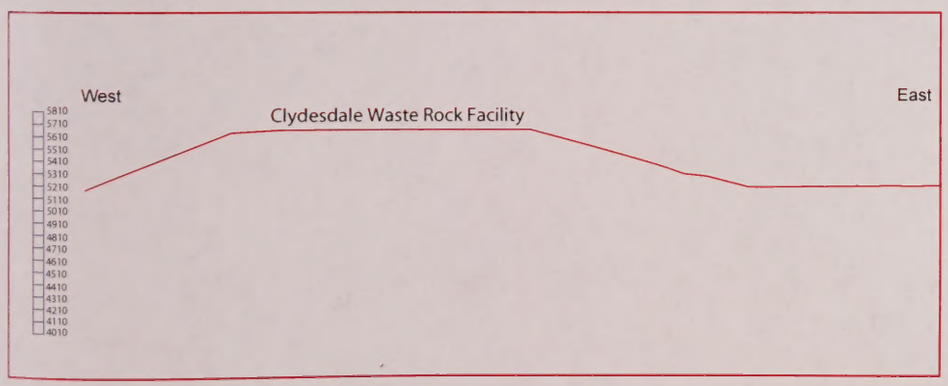
Tailings resulting from the processing of the mill-grade ore would be disposed of in a new tailings facility (Goldstrike No. 3 Tailings Facility). The Goldstrike No. 3 Tailings Facility would be located within the Brush Creek watershed, north of the existing AA Tailings Impoundment and south of the North Block Tailings Facility (**Figure 2-11**). The proposed facility would be constructed over the existing (inactive) Mill #4 Tailings Facility. The Mill #4 Tailings Facility is in temporary closure status (NAC 445.44) (NDEP 2005a). The presence of the Mill #4 Tailings Facility has required a modified design of the Goldstrike No. 3 Tailings Facility. The base of the Goldstrike No. 3 Tailings Facility has been designed with a footprint much larger than would be the case if the Mill #4 Tailings Facility were not present. This additional footprint, which provides a great deal of additional mass to support the dam, ensures the stability and safety of the new tailings dam as it is constructed over the older tailings facility. Construction of the proposed facility would occur in 2010 with operations beginning in 2011.

Dams, including tailings dams, constructed within the State of Nevada are regulated by the State Engineer as set forth in the NRS, Title 48 - Water, Chapter 532 – State Engineer. The State Engineer has produced regulations published in the NAC Chapter 535 – Dams and Other Obstructions. These regulations may be referenced at: http:\www.leg.state.nv.us/NAC/NAC-535.html. These regulations state in part that dams shall be designed by and constructed under the direct supervision of a Registered Professional Engineer by a licensed contractor, (NAC 535.260). The regulations also set forth certain minimum design criteria including those

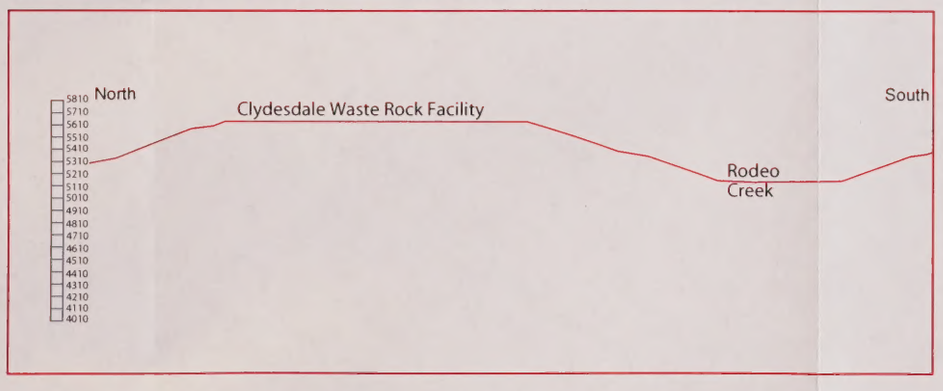




West-East Section



North-South Section



LEGEND

- Goldstrike Mine Operations Boundary
- Streams
- Retention Ponds
- Cross-section
- Culverts
- Rodeo Creek Channel Abandoned

Source: BGMI and SRK 2007.

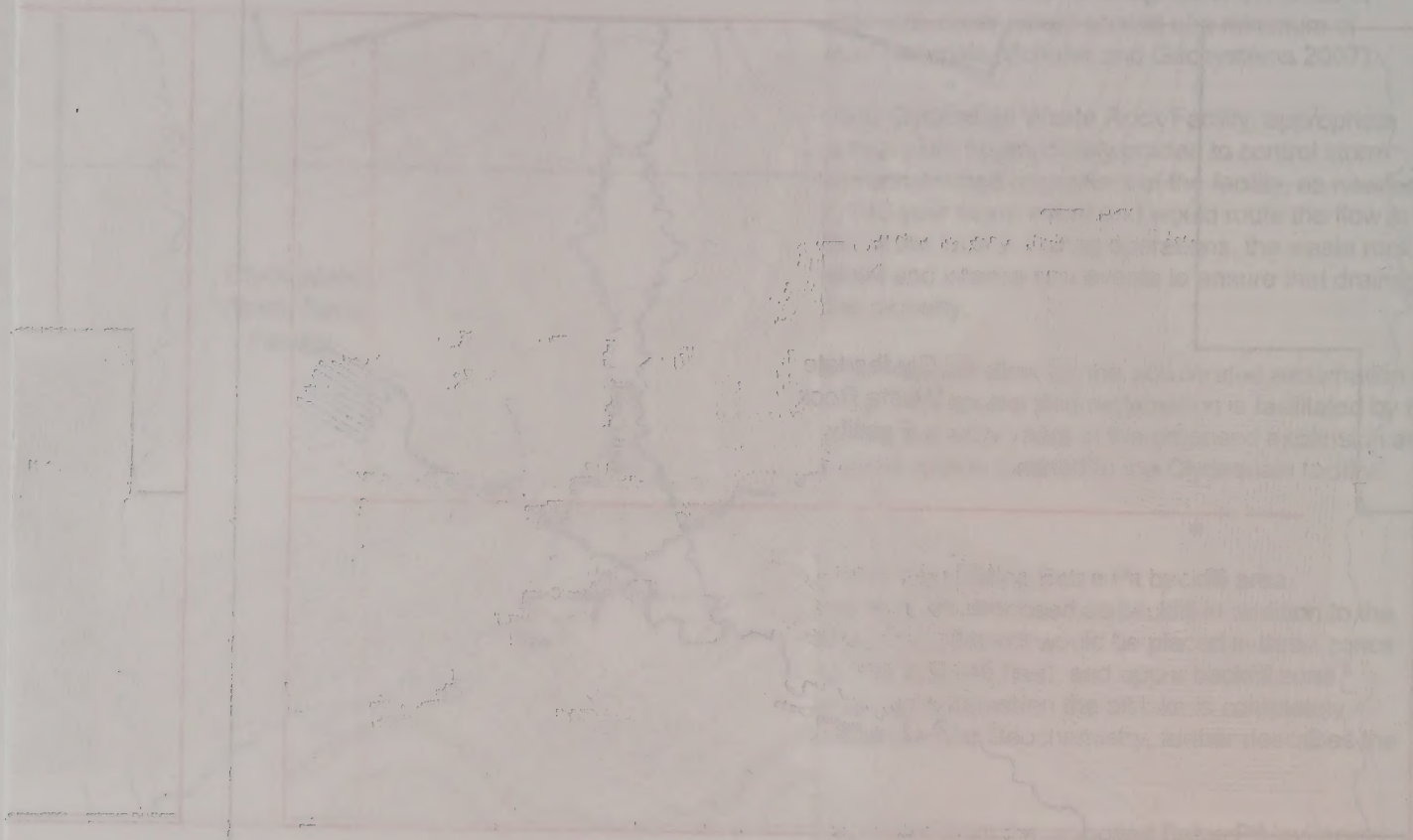
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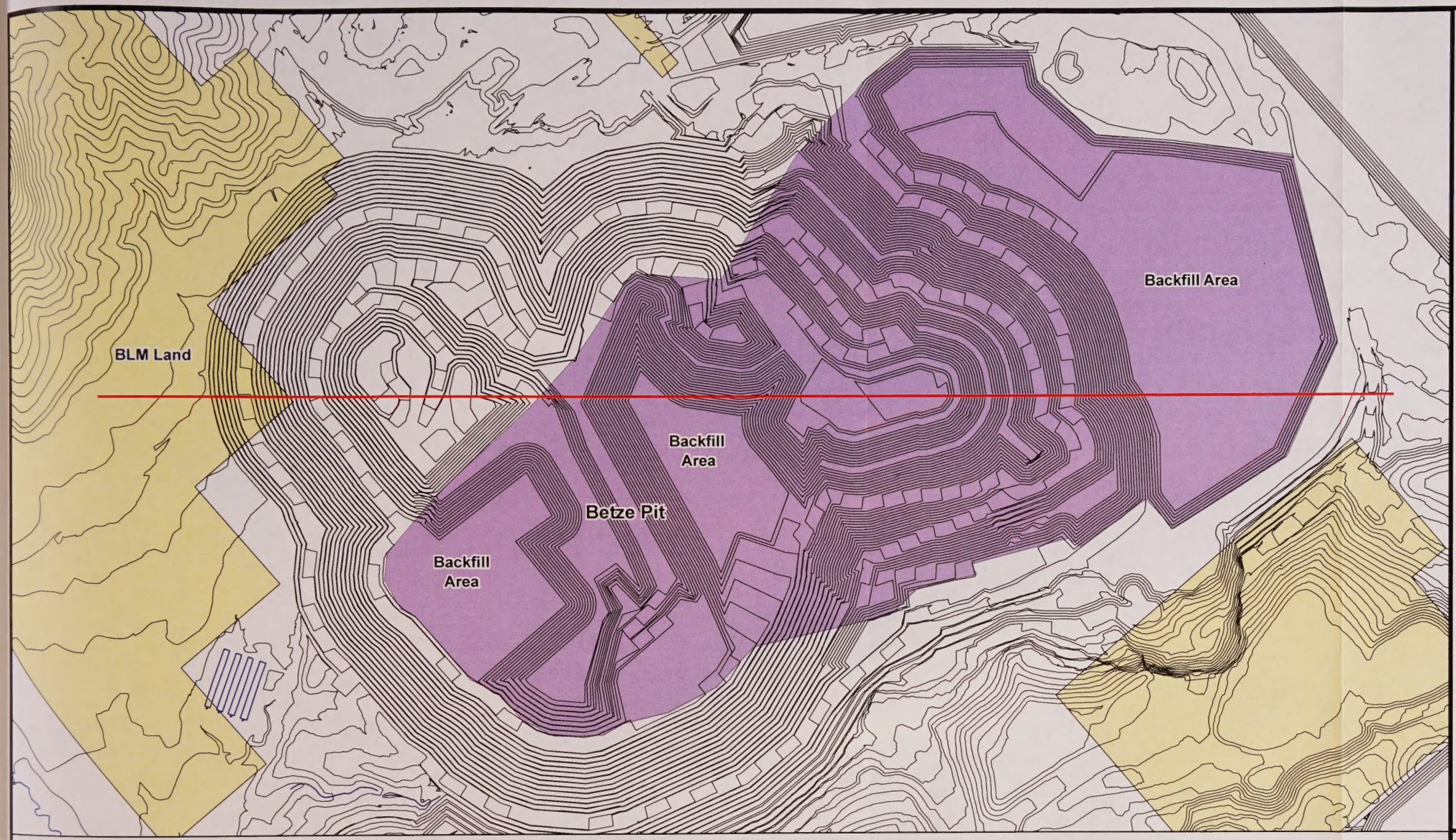
0 1000' 2000'
Feet

Betze Pit Expansion Project

Figure 2-12

Clydesdale Cross-section and Profile





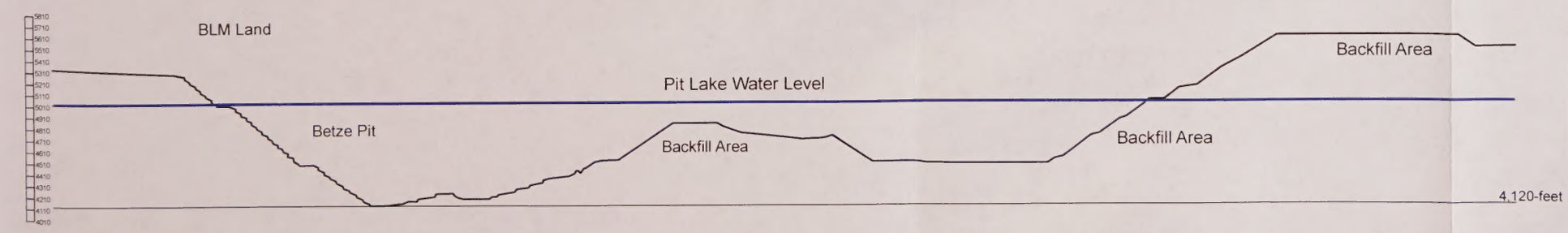
LEGEND

- Cross Section
- Streams
- Retention Ponds
- Waste Rock Backfill Area
- BLM Land

Note: Contour Interval 20-feet.

Source: BGMI and SRK 2007; BGMI 2008a.

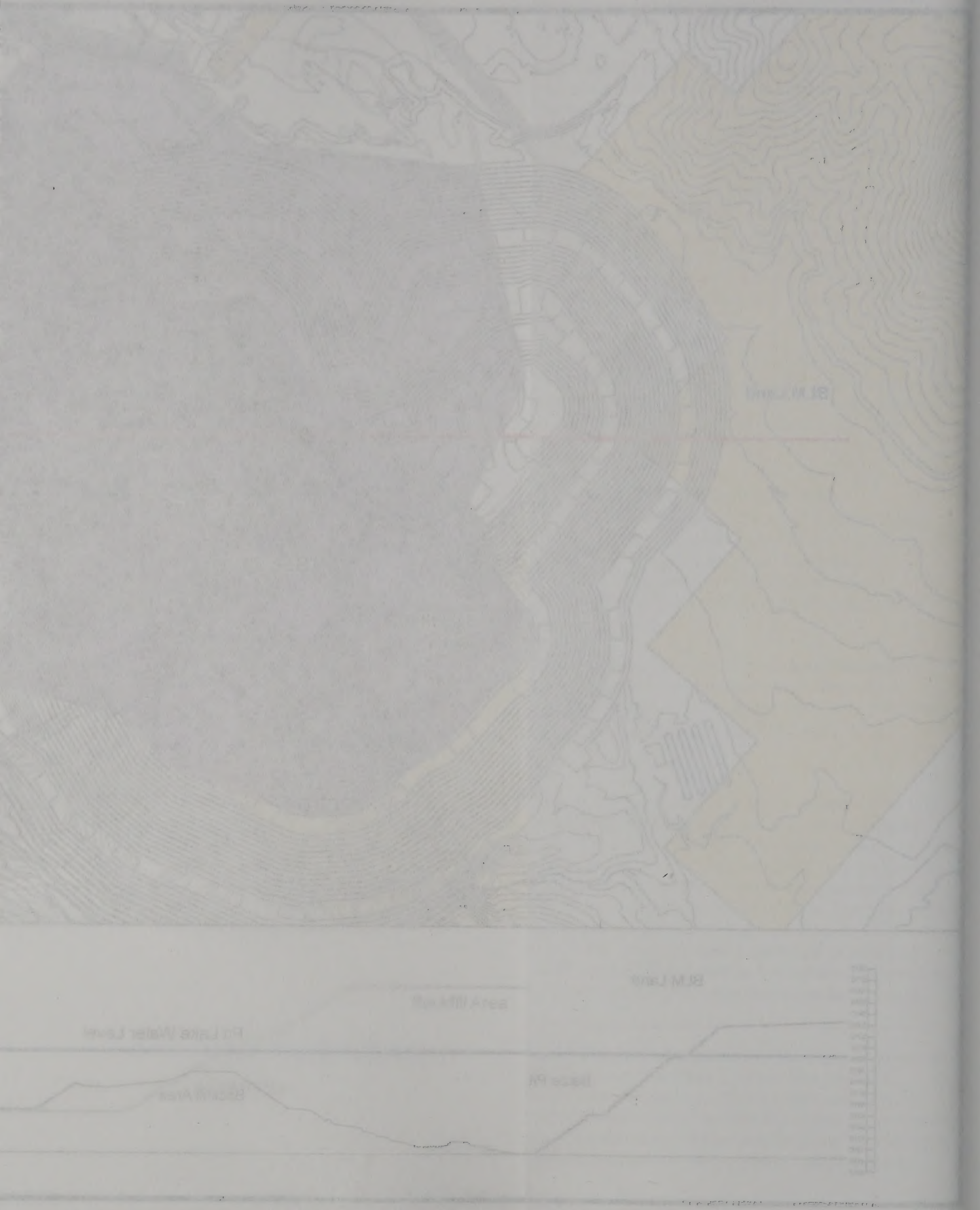
0 0.2 0.4 Miles



Betze Pit Expansion Project

Figure 2-13

Betze Pit Backfill Areas



concerning seismic stability (NAC 535.250). Additionally, the regulations stipulate that dams be periodically inspected by either the State Engineer's Office and the owner. These inspections are performed by a Registered Professional Engineer. Any defects or substandard conditions are noted and detailed in a report to the State Engineer who has the authority to order repairs. The proposed tailings facility would be constructed and operated according to these regulations. **Figure 2-14** shows the Goldstrike No. 3 Tailings Facility profile.

Facility Design

The Goldstrike No. 3 Tailings Disposal Facility design incorporates a zoned earth/rockfill dam with an ultimate crest elevation of 5,725 feet amsl. The facility embankment footprint would cover approximately 201 acres and would have a maximum height (crest to downstream toe) of approximately 335 feet. At its ultimate configuration, the facility would store approximately 115.4 million tons of tailings (assuming a dry density of 85 pounds per cubic foot), and the ultimate tailings surface would cover approximately 537 acres. A total footprint of 690 acres of land would ultimately be disturbed (644 acres of private land and 46 acres of public land). The total acreage of the embankment and the ultimate tailings surface exceed the final disturbance area because at its ultimate configuration, the tailings would be deposited over the upstream portion of the embankment disturbance (**Figure 2-14**).

The facility will be double lined with a leak capture system between the liners. Leaks will likely not occur for at least the life of the liner, which is conservatively estimated to be more than 200 years (Rowe 2005).

The tailings facility dam would be constructed in up to four stages using modified centerline construction techniques. A minimum crest width of 150 feet would be maintained to allow the embankment to be constructed using the existing mine construction equipment. The downstream embankment slopes would be constructed at a maximum slope of 2.5H:1V, while upstream slopes would be constructed at a maximum slope of 3H:1V to allow a 60-mil (1.5 millimeters) linear low density polyethylene (LLDPE) liner to be installed in the impoundment. The liner system in the impoundment and on the upstream face of the dam would be a composite liner, consisting of a compacted soil liner. The liner system would meet or exceed the NDEP requirement to provide protection equivalent to that of 12 inches of compacted soil with a maximum saturated hydraulic conductivity of $1x10^{-6}$ (centimeters per second [cm/sec]) overlain by a 60-mil LLDPE geosynthetic liner. These design specifications also would meet or exceed requirements under 43 CFR Subpart 3809 regulations and BLM guidance.

The embankment would incorporate an internal drain layer on the upstream face of the dam to capture seepage that may enter the embankment fill and prevent the development of a piezometric surface in the dam. The drain layer would be constructed using free-draining, durable, non-acid generating rock derived from mine operations.

The impoundment area would incorporate an underdrain system, which would be constructed beneath the composite liner to capture flows from springs or seeps within the Brush Creek basin, as well as an overdrain system, which would be constructed on top of the composite liner system to capture seepage from the tailings, aid tailings consolidation, and minimize head on the liner system. The underdrain system would consist of gravel drains with perforated high-density polyethylene (HDPE) pipes to efficiently collect flows and convey them downstream of the proposed embankment. In lieu of using gravel and perforated HDPE pipes, fabric wrapped polyethylene wick drains may be used for seepage collection above the liner. The wick drains would drain to a small gravel drain with a perforated collection pipe. During operations, the captured flow from the overdrain system would drain to a seepage collection sump downstream of the embankment, and then pumped back into the impoundment.

BGMI intends to extend the existing tailings pipelines that were terminated on the south leg of the North Block Tailings Dam to the proposed Goldstrike No. 3 Tailings Facility. Three 14-inch-diameter HDPE-lined steel pipelines would deliver tailings to the proposed tailings impoundment and one 14-inch steel pipeline would convey recycled process solution back to the roaster area. (**Figure 2-11**). These pipelines would be located

aboveground in a plastic-lined secondary containment corridor. A water reclaim pumping system would return water from the impoundment to the mill for reuse via the reclaim pipeline.

Surface water run-on would be controlled by the existing Brush Creek Diversion Channel. The diversion channel is located above (upgradient of) the ultimate tailings elevation and areal extent and is designed to convey the peak flow due to a 100-year/24-hour storm event occurring upstream of the diversion. The diverted Brush Creek eventually discharges into the Rodeo Creek Diversion Channel downstream of the existing Rodeo Creek Diversion Dam.

Facility Construction

The Goldstrike No. 3 Tailings Facility embankment and tailings impoundment area would be constructed in approximately four stages, depending on tailings production rates (**Figure 2-14**). Based on the anticipated production rates, the proposed stages and minimum elevations for each stage are provided in **Table 2-11**.

Table 2-11 Proposed Staged Construction of Goldstrike No. 3 Tailings Facility

Stage	Minimum Elevation (feet amsl)[1]
1 (Initial Construction)	5,600
2	5,654
3	5,688
4	5,725

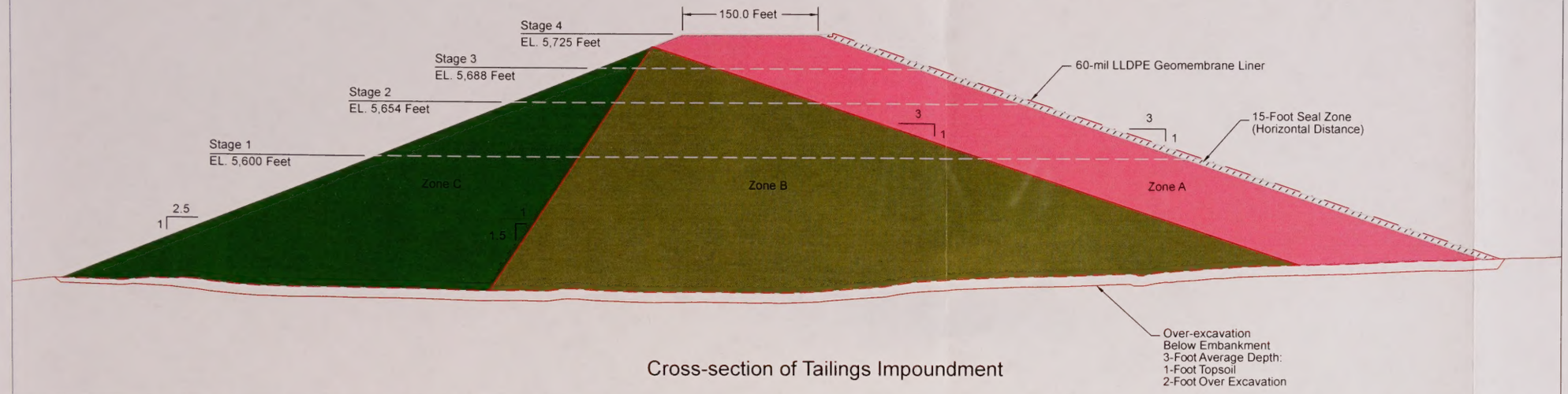
[1]Minimum elevation refers to the elevation of the lined portion of the embankment and the lined portion of the impoundment that would be constructed during each stage.

Source: BGMI and SRK 2007.

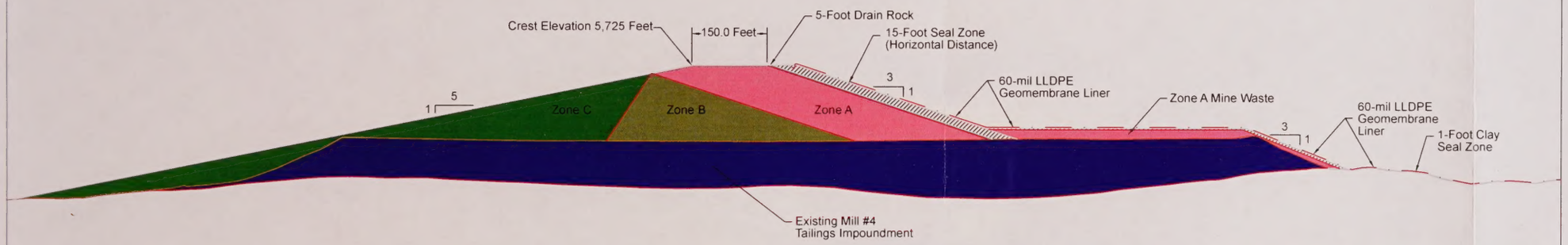
The footprint of the embankment would be prepared by stripping topsoil and over-excavating approximately 2 feet of foundation soils. The embankment would be constructed using modified centerline raise techniques; the maximum embankment footprint would be prepared during Stage 1 of construction. The foundation of the areas to be lined within the impoundment during later stages (Stages 2 through 4) would be prepared immediately prior to liner installation of that stage, as shown on **Figure 2-14**.

Embankment construction would use durable, non-PAG rock derived from open-pit mining operations at the Goldstrike Mine. Construction materials would be hauled and placed using the mine's existing haul trucks. The materials to be placed in the embankment are identified as Zone A, Zone B, or Zone C fills as shown in **Figure 2-14**. Each of the zones has a different specification for maximum lift thickness. Zone A fill would be placed in 4-foot lifts (maximum) if placed by mine equipment or 18-inch (maximum) lifts if placed using smaller equipment. Zone B would be placed in 8-foot lifts (maximum) using mine equipment, and Zone C fill would be placed in lifts with the maximum lift thickness to be determined during construction. In all cases, where mine equipment would be hauling and placing fill, compaction would be achieved by routing the haul trucks over the fills. This construction method is identical to that used in the construction of the existing North Block Tailings Facility embankments.

The liner system for the embankment would be constructed over the Zone A fill that would be placed on the upstream slope of the embankment. The liner system would consist of a compacted soil liner that meets or exceeds the NDEP requirement to provide protection equivalent to that of 12 inches of compacted soil with a maximum saturated hydraulic conductivity of 1×10^{-6} cm/sec, and a 60-mil LLDPE geosynthetic liner. Both the compacted soil liner and the LLDPE liner would be installed by a contractor. Third-party construction quality



Cross-section of Tailings Impoundment



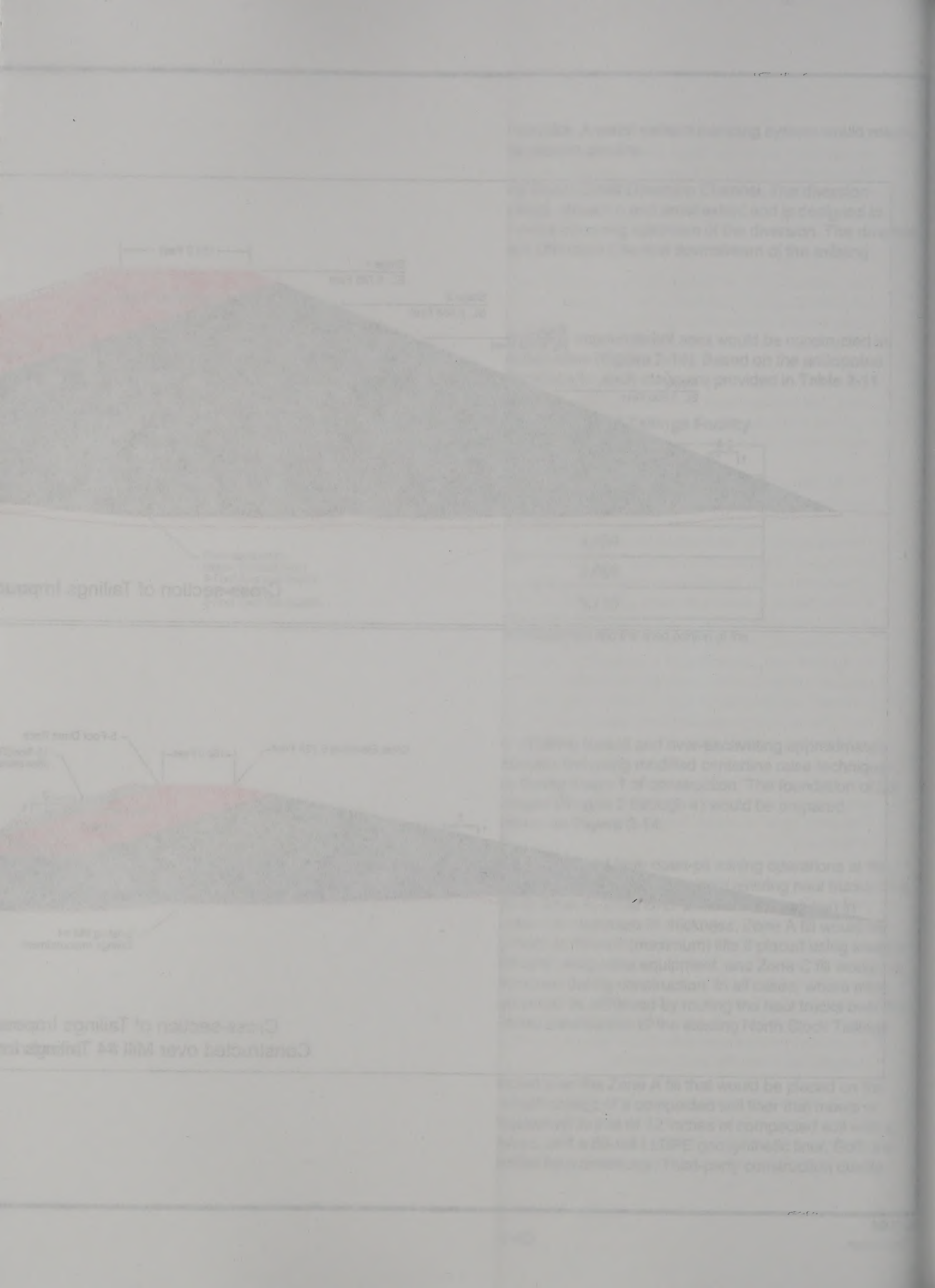
Cross-section of Tailings Impoundment
Constructed over Mill #4 Tailings Impoundment

Source: BGMI and SRK 2007.

Betze Pit Expansion Project

Figure 2-14

Goldstrike No. 3
Tailings Facility Profile



assurance would be provided for the soil liner and geosynthetic liner installation, as well as underdrain and overdrain construction to ensure the installation would be completed according to the technical specifications developed for the project during final design.

All necessary construction permits and modifications to operating permits would be obtained from the NDEP, BMRR, NDWR, and NDOW prior to initiation of facility construction.

Facility Operation

The Goldstrike No. 3 Tailings Facility would store thickened tailings as opposed to conventional slurried tailings to maximize storage volume and minimize long-term (closure or post-closure) management related to the consolidation and draindown of interstitial fluids contained within the tailings. The target for thickened tailings production is to produce a product containing 50 to 55 percent solids by weight. By means of comparison, the conventional tailings that are currently deposited in the existing North Block Tailings Facility are deposited at an average solids concentration of approximately 35 percent solids by weight. This thickened tailing has a decreased water content, higher density, and is expected to have a decreased draindown time over a conventional tailings facility.

The tailings would be deposited into the impoundment primarily from the west side of the impoundment to form a beach sloping toward the east, which also is away from the embankment. A small water pool is anticipated to form away from the embankment in response to the inflow of meteoric water from precipitation. Since the tailings would be deposited at a high solids content (50 to 55 percent solids, by weight), bleed water from the tailings would be minimized. The spigot locations would be rotated on a regular basis to distribute the tailings evenly throughout the impoundment and to ensure drying and consolidation of the tailings is maximized.

The facility would be operated as a zero discharge facility; as such, there would not be an emergency spillway constructed during operations. The facility is designed to store all anticipated inflows up to the Probable Maximum Flood determined for the facility. In the event of a large magnitude precipitation event, the facility would be able to store the accumulated runoff and eliminate the excess accumulated water by consuming it within the process circuit as is currently done in the existing North Block Tailings Facility. Tailing delivered to this facility will have undergone a cyanide destruct process. This process treats the tailings to a cyanide level that is below that considered to be harmful to waterfowl and wildlife (50 parts per million [ppm]) (Donato et al. 2007). The Roaster currently uses the INCO process, which utilizes sulfur dioxide (SO_2) and air along with ammonium bi-sulfite.

Facility Monitoring and Maintenance

The proposed Goldstrike No. 3 Tailings Facility components would undergo regular inspection, monitoring, and maintenance. These include the tailings distribution pumps, the tailings distribution pipelines, valves, and spigots, the water reclaim pump, and the water reclaim pipeline and valves. The tailings distribution and water reclaim systems would be checked daily for leaks and to ensure the pumps were functioning properly.

During facility operation, the process components would be inspected on a daily basis. Other facility components, such as the embankment itself, the lining system, the overdrain system, and the underdrain system would be periodically monitored. Examples of periodic monitoring include:

- Performing quarterly topographic surveys of the tailings and the water pool;
- Obtaining regular readings of instrumentation installed in the embankment (i.e., inclinometers and vibrating wire piezometers);
- Obtaining readings of instrumentation installed within the tailings and drainage components (i.e., vibrating wire piezometers);
- Obtaining readings from flowmeters measuring flow from the overdrain and underdrain systems; and

- Performing visual inspections of the embankment, the tailings impoundment area, and flow components.

Samples of overdrain and underdrain flows would be taken periodically to check the chemistry of the flows and sent to a NDEP-certified analytical testing laboratory for analysis. The frequency of the readings of the instrumentation and sampling of flows would vary between weekly and quarterly, depending upon the performance of each of the facility components. In the event there is any concern regarding the performance of any specific components, the frequency of readings or observations would be increased to ensure proper operation. Thorough dam safety inspections would be completed annually in accordance with BGMI's corporate policies on dam safety as well as those established by the NDWR.

2.3.5.5 Electric Utilities

In order to accommodate construction of the proposed Clydesdale Waste Rock Facility, the existing 120-kilovolt (kV) powerline would be rerouted around the south and west part of the proposed facility. A total of 7,500 feet of transmission line would be removed and 9,500 feet would be installed as part of the Proposed Action.

2.3.6 Applicant-committed Environmental Protection Measures

During construction and operation of the Betze Pit Expansion Project, BGMI would implement applicant-committed environmental protection measures to mitigate potential impacts to air, land, water, wildlife, cultural resources, and human resources and to prevent undue or unnecessary degradation of the resources in the project area as part of the proposed project's standard operating procedures. Pre-development planning, pollution prevention measures, and pollution control measures and equipment would be used to reduce potential project-generated environmental impacts.

Proposed environmental protection measures applicable to the Proposed Action have been adopted from the Amendment to the POO (NVN-70708), (BGMI and SRK 2007), Betze Project SEIS (BLM 2003a), and Betze Project EIS (BLM 1991a,b). These measures are identified below.

2.3.6.1 Geology

- Geotechnical monitoring, consisting of geologic structure mapping, groundwater monitoring, and slope stability analyses, would be conducted during active mining to assist in optimizing the final pit design. Slope movement monitoring also would be initiated to evaluate the safety of the open-pit high walls. In addition, operational procedures for controlling blasting and bench scaling would facilitate mining with stable pit walls.

2.3.6.2 Water Resources

- To minimize impacts to water resources, the proposed new tailings facility would be designed and operated as a zero discharge facility, with a composite liner system in accordance with NDEP criteria.
- Selective placement of waste rock, as needed, and routine monitoring of the waste rock disposal facilities (Clydesdale and Betze Pit backfill) during operations would be implemented to reduce the potential for acid rock drainage.
- To limit erosion and reduce sediment transport from project disturbance areas, erosion control measures, as outlined in the project's SWPPP and Reclamation Plan, would be installed as needed and maintained. To further reduce erosion potential, storm water diversions would be installed upgradient and around project facilities, as needed, to divert storm water runoff around disturbance areas. Facilities would be graded appropriately and monitored following spring snowmelt and intense rain events to ensure that drainage and sediment control measures are effective and operating properly. In addition, implementation of concurrent reclamation would further reduce erosion potential.

- Groundwater monitoring would be conducted to ensure compliance with permit criteria and to provide for early identification of potential impacts. The existing groundwater monitoring plan would be updated as necessary to include new facilities.
- All mineral exploration and development drill holes, and monitoring and observation wells would be properly plugged and abandoned following completion of their functions to prevent contamination of groundwater resources.
- One hundred tons of limestone would be placed in the pit bottom to act as a neutralizing buffer for any potentially acidic runoff which may occur during the initial years prior to the groundwater table's recharge above the pit floor. This potentially acidic runoff may occur in the pit lake regardless of Rodeo Creek Diversion closure option when meteoric water falls upon and travels over exposed PAG wall rock prior to the formation of the pit lake.

2.3.6.3 Soils, Vegetation, and Invasive and Non-native Species

- To minimize impacts to soils and provide for re-establishment of vegetation, suitable growth media would be salvaged and stockpiled during the Betze Pit expansion and during Clydesdale Waste Rock Facility construction for subsequent use in reclamation. The growth media also would be transported to, and redistributed on, mine-related surface disturbance areas undergoing concurrent reclamation (e.g., Bazza Waste Rock Facility).
- BMPs, as described in BGMI's SWPPP for Industrial Activities (JBR 2003), and conditions specified in the storm water permit (NVR300000) issued June 1, 2007, would be implemented to limit erosion from project facilities and disturbance areas during and following construction, operations, and initial stages of reclamation. These practices may include, but would not be limited to, installation of storm water diversions to route water around disturbance areas and project facilities using accepted engineering practices, and the placement of erosion control devices (e.g., silt fences, staked weed-free straw bales, riprap, sediment traps, etc. To ensure long-term erosion control, all sediment and erosion control measures would be inspected periodically, and repairs would be performed as needed.
- Waste rock facilities would be contoured where feasible to provide for the most hydrologically stable reclamation landform possible. Channel morphology and grade and bed materials would be designed to resemble natural drainage features whenever feasible.
- Revegetation of disturbance areas would be conducted as soon as practical to reduce the potential for wind and water erosion, minimize impacts to soils and vegetation, help prevent the spread of invasive and non-native species in disturbance areas, and facilitate post-mining land uses. Following construction activities, areas such as cut-and-fill embankments and growth media stockpiles would be seeded. Concurrent reclamation would be conducted to the extent practical to accelerate revegetation of disturbance areas. All sediment and erosion control measures and revegetated areas would be inspected periodically to ensure long-term erosion control and successful reclamation, and repairs would be performed as needed.
- To minimize the introduction and spread of noxious weeds in project-related disturbance areas, revegetation efforts described in the 2006 Goldstrike Mine Revegetation Efforts, Monitoring, Evaluation, and Recommendations Report would be implemented (Cedar Creek Associates 2007a). The plan outlines procedures for the prevention, monitoring, and treatment of noxious weed infestations. The results of the monitoring program would provide the basis for updating the plan, if needed.
- Seed Company certified weed-free seed mixes would be used for reclamation.

2.3.6.4 Wildlife and Special Status Species

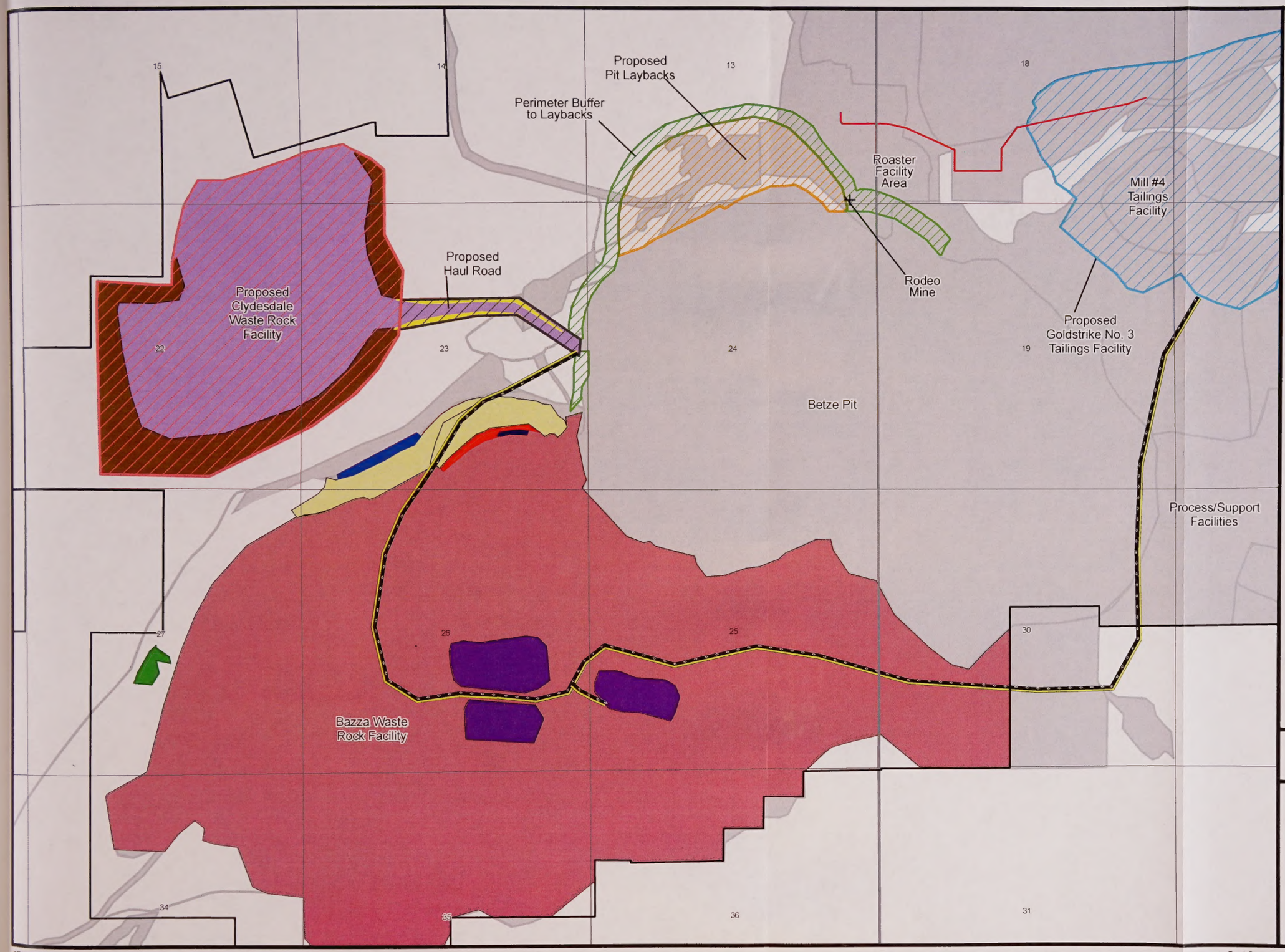
- To minimize potential impacts to wildlife species, weak acid dissociable (WAD) cyanide concentrations in the tailings impoundments would be maintained at non-lethal levels.

- In the event that initiation of the proposed project should occur during the raptor nesting season (March 1 through July 31), a raptor survey would be conducted, and appropriate mitigation measures, such as buffer zones around occupied nests, would be developed and implemented, as needed.
- To protect nesting birds, removal of migratory bird habitat on currently undisturbed lands in the project area would be avoided to the extent possible between March 1 and July 31. Should removal of habitat be required during this period, BGMI would coordinate with the BLM and NDOW to conduct breeding bird surveys and implement appropriate mitigation, such as buffer zones around occupied nests, as needed.
- To minimize wildlife/vehicle-related collision impacts during project operations, BGMI would continue its mandatory employee education program for all personnel.
- The rerouted transmission line segment would be designed and constructed to follow Avian Powerline Interaction Committee (APLIC) guidelines to minimize raptor electrocution potential. Anti-perching features would be incorporated on the rerouted transmission line segment to minimize raptor predation on greater sage-grouse. These measures are required by the 1991 Betze Project ROD.
- BGMI will assist in big game migration data collection by measures set forth by the BLM and NDOW. BGMI also will work with BLM, NDOW, and other mining proponents for a long-term solution to preserving the Area 6 big game migration corridor.
- To maintain the wildlife migration corridor near the Clydesdale Waste Rock Facility, the western portions of the Bazza Waste Rock Facility will be reclaimed concurrently or before the initial stages of the Clydesdale Waste Rock Facility construction (**Figure 2-15**). In accordance with environmental controls overseen by NDEP, material will be placed on the eastern edge of the Clydesdale Waste Rock Facility first so that reclamation can begin as soon as possible, progressing the Clydesdale's construction from east to west to allow reclamation that will reestablish the mule deer migration corridor in the least amount of time.
- Implementation of the proposed Reclamation Plan would minimize habitat impacts for wildlife species. Implementation of the plan also would minimize impacts to range resources through the re-establishment of forage.

2.3.6.5 Cultural Resources

- Five historic properties (i.e., sites eligible for nomination to the National Register of Historic Places [NRHP]) would be impacted by the expansion project. A treatment plan for the five historic properties within the proposed expansion was developed by a BLM approved archaeological contractor. BLM and State Historic Preservation Office (SHPO) reviewed and approved the plan as specified in the 1991 Programmatic Agreement (PA). The contractor completed the field work in the fall of 2007, and analysis and write-up are underway. The draft report will be submitted by July 11, 2008, for review and approval by BLM and SHPO.
- If previously undocumented cultural resource sites are discovered during construction of the mine facilities, construction would be halted in the area of the discovery, and the BLM Authorized Officer would be contacted to evaluate the find. If the site is eligible for listing on the NRHP, impacts would be mitigated through avoidance or an appropriate data recovery program developed pursuant to the 1991 PA among the BLM, Nevada SHPO, and BGMI.

BGMI would train employees and contractors in their responsibilities to protect cultural resources and enforce BGMI's policy against off-road cross-country travel and the removal of artifacts. BGMI also would implement a site monitoring program to ensure that damage does not occur to the remaining historic properties.



LEGEND

- Goldstrike Mine Operations Boundary
- Tailings Facility
- Pit Expansion
- Perimeter Buffer to Laybacks
- Waste Rock Facility
- Clydesdale Haul Road
- Previous Disturbance
- Tailings Pipelines

Reclamation Timing[1]

- 1990
- 1995
- 2000
- 2001
- 2002
- 2009 - 2012
- 2010
- 2013
- 2016 - 2018
- 2033 - 2035
- Stockpile Access Road

[1]All dates are dependent on January 2009 start.

Source: BGMI and SRK 2007; BGMI 2007a, 2008a.

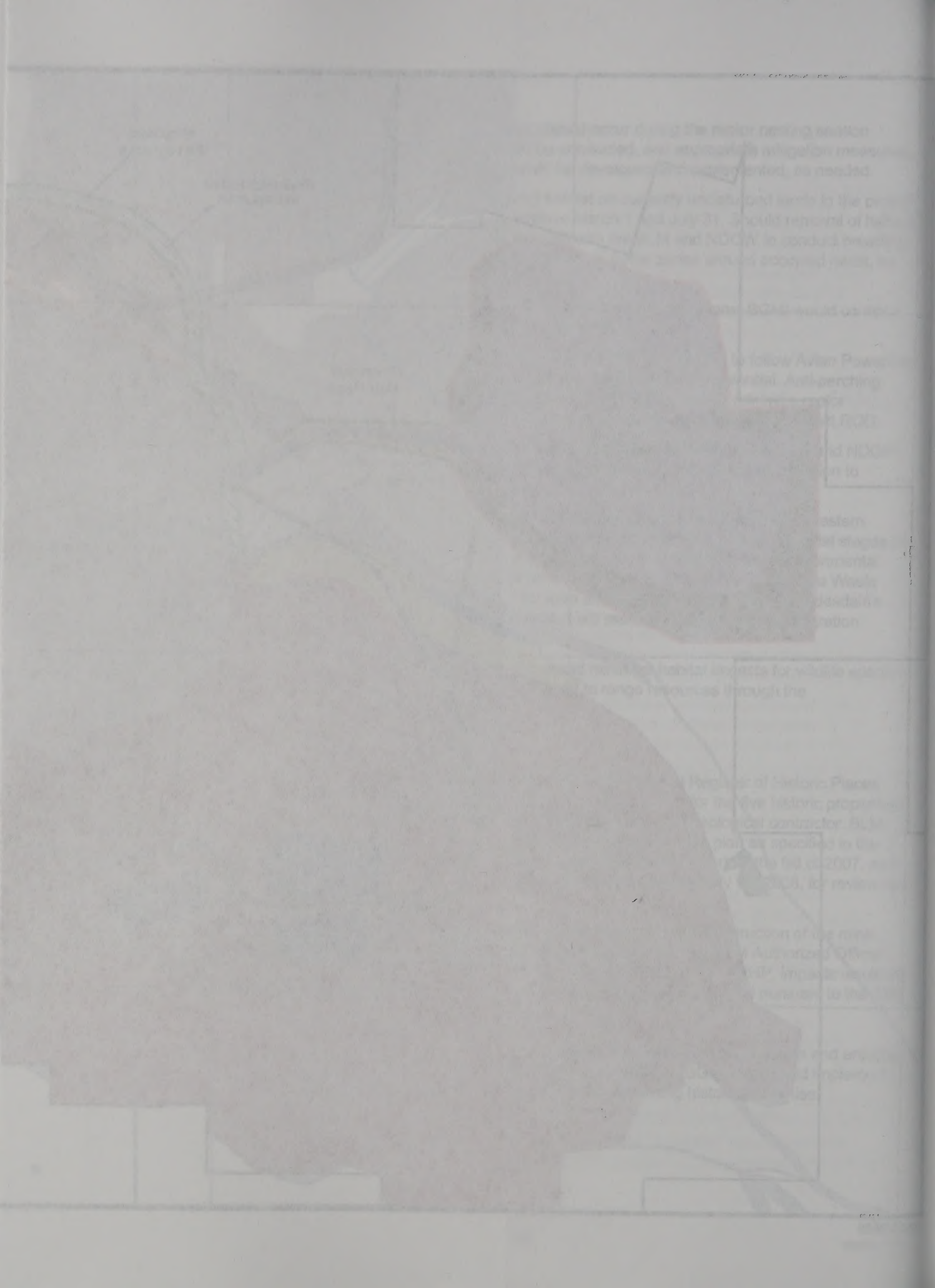
N W E S

0 0.25 0.5 Miles

Betze Pit Expansion Project

Figure 2-15

Reclamation Chronology: Clydesdale and Bazza Waste Rock Facilities



2.3.6.6 Air Quality

- Fugitive dust controls, including water application on haul roads and other disturbed areas, chemical dust suppressant application (e.g., magnesium chloride), where appropriate, and application of other BMPs as approved by the NDEP Bureau of Air Pollution Control (BAPC), currently are, and would continue to be, implemented.
- The Goldstrike Mine currently operates with state-of-the-art mercury controls on its process facilities. Controls would be periodically evaluated and upgraded in accordance with the State of Nevada Mercury Control Program, which requires the incorporation of Maximum Achievable Control Technology (MACT).
- Temporary disturbance areas (e.g., growth media stockpiles, cut and fill embankments, etc.) would be seeded with an interim seed mix, and concurrent reclamation would be implemented on completed portions of the waste rock facilities, thereby minimizing fugitive dust emissions.
- To control combustion emissions, all manufacturer installed pollution control equipment would be operated and maintained in good working order.

2.3.6.7 Socioeconomics

- Development of post-mining land use plans may include future utilization of mine infrastructure for long-term economic benefits for the region.

2.3.6.8 Visual Resources

- During operations, the margins of the waste rock facilities would be constructed to provide for variable topography during final regrading, thereby providing a more natural post-mining landscape.
- Following the completion of mining, structures and buildings may be dismantled and removed from the site.
- Concurrent reclamation would be implemented to the extent possible.
- Waste rock facilities would be contoured where feasible to provide a natural looking post-reclamation land form.

2.3.6.9 Hazardous Materials

- Prior to initiation of the project, the existing Environmental Incident Response Manual (BGMI 2007b) would be amended, as necessary, to include the Betze Pit Expansion Project. Implementation of the prevention, containment, and cleanup procedures in this plan would minimize the potential for related impacts to soils, vegetation, wildlife, and water resources.
- Prior to initiation of the project, the existing Solid and Hazardous Waste Management Plan (JBR 2006) would be amended, as necessary, to include the Betze Pit Expansion Project. Implementation of the management procedures for the handling of solid and hazardous waste generated at the site, reagent storage, transportation, and handling requirements would minimize the potential for related impacts to soils, vegetation, wildlife, and water resources.

2.3.6.10 General Measures

- To the extent practical, BGMI would protect all survey monuments, witness corners, reference monuments, bearing trees, and line trees against unnecessary or undue destruction or damage. Public land survey system monuments would be protected and preserved in accordance with Nevada BLM Instructional Memorandum (IM) No. NV-2007-003. If destroyed, BGMI immediately would report the matter to the Authorized Officer.

2.3.7 Reclamation and Site Closure Plans

2.3.7.1 Changes to Existing Mine Reclamation Plans

Reclamation of the currently permitted facilities would continue to be conducted in accordance with the previously approved Revised Reclamation Plan and 2007 Three-year Update for the Goldstrike Mine Project (BGMI 2007e). This plan provided the basis for development of the draft reclamation plan for the proposed Betze Pit Expansion Project, as presented in the Amendment to the POO (NVN-70708) and Reclamation Permit (0026) for the Expansion of the Betze Pit, the Goldstrike No. 3 Tailings Facility and the Clydesdale Waste Rock Facility (BGMI and SRK 2007). Prior to initiation of the project, the reclamation plan would be revised, if needed, and submitted to the BLM and NDEP for final approval. The intent of the project's reclamation program is to restore the project area to a beneficial post-mining land use, prevent undue or unnecessary degradation to resources, and reclaim disturbed areas such that they would be visually and functionally compatible with the surrounding topography.

The areas of proposed disturbance include the following components: pit laybacks, waste rock facilities, tailings facility, tailings pipeline, powerline relocation, and haul road (see **Table 2-6**). With the exception of pit highwalls, ramps, and floors, all of the surface disturbance associated with these mine components would be reclaimed. Non-highwall portions of the open pit above the predicted pit lake level would be revegetated to the extent practicable.

BGMI believes that terminating Rodeo Creek into the Betze Pit at the end of mining is the best choice for the long-term management of Rodeo Creek. The potential diversion of Rodeo Creek in to the Betze Pit at the end of mining is a closure option. To that end, BGMI will apply for the necessary permits from the State of Nevada at the time of mine closure. If such a permit is not granted, Rodeo Creek will remain as a diversion on the south side of the pit, entirely on privately held lands. In either case, no permit from the BLM is necessary.

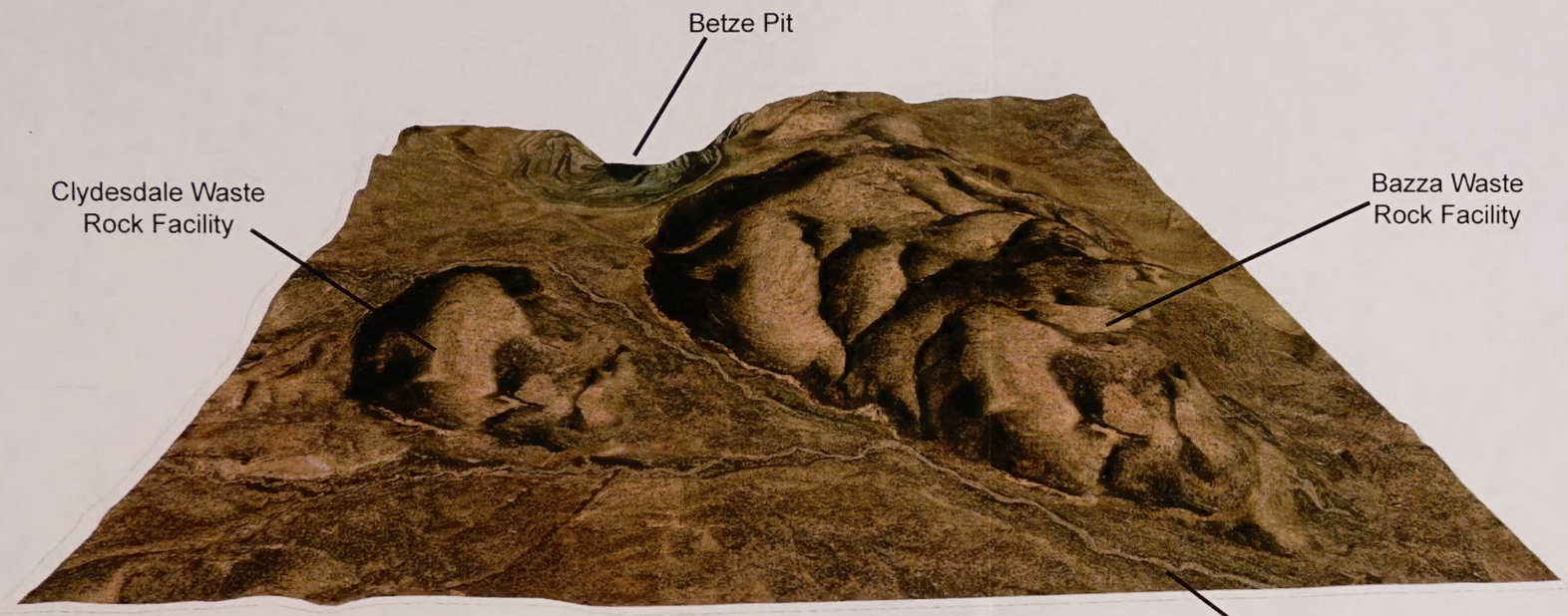
The final grading plan for the project is designed in part to minimize the visual impacts of unnatural lines and landforms. Slopes would be regraded to blend with surrounding topography, to the extent possible, and facilitate revegetation. Where feasible, large constructed topographic features such as the Clydesdale Waste Rock Facility may have rounded crests and variable slope angles to more closely resemble natural landforms. The Betze Pit would remain as a large depression partially filled with water. The conceptual post-mining reclamation topography is shown in **Figure 2-16**.

Revegetation of disturbance areas would be conducted as soon as practical to reduce the potential for wind and water erosion. Following construction activities, areas such as cut-and-fill embankments and growth media stockpiles would be seeded. Concurrent reclamation would be conducted to the extent practical to accelerate revegetation of disturbance areas. Reclamation of the Bazza Waste Rock Facility would be accelerated. All sediment and erosion control measures and revegetated areas would be inspected periodically to ensure long-term erosion control and successful reclamation.

2.3.7.2 Proposed Reclamation Schedule

Upon completion of mining, final waste rock facility reclamation would be completed pursuant to the final closure plan and schedule that would be submitted to the BLM and NDEP for approval. The detailed closure plan for each process facility component would be prepared at least 2 years prior to the anticipated closure date (NAC 445A.447), and would conform with the Water Pollution Control Permit regulations in effect at the time of closure.

The proposed pit expansion would be active for approximately 4 years (2012-2015). The Clydesdale Waste Rock Facility would be active from approximately 2009 through 2015, accepting waste rock from currently authorized pit expansion as well as from the proposed pit expansion. Concurrent reclamation of the eastern, southern, and southwestern perimeters of the Clydesdale Waste Rock Facility closest to the mule deer migration corridor would be reclaimed first beginning in 2013 (**Figure 2-15**). Recontouring, growth media

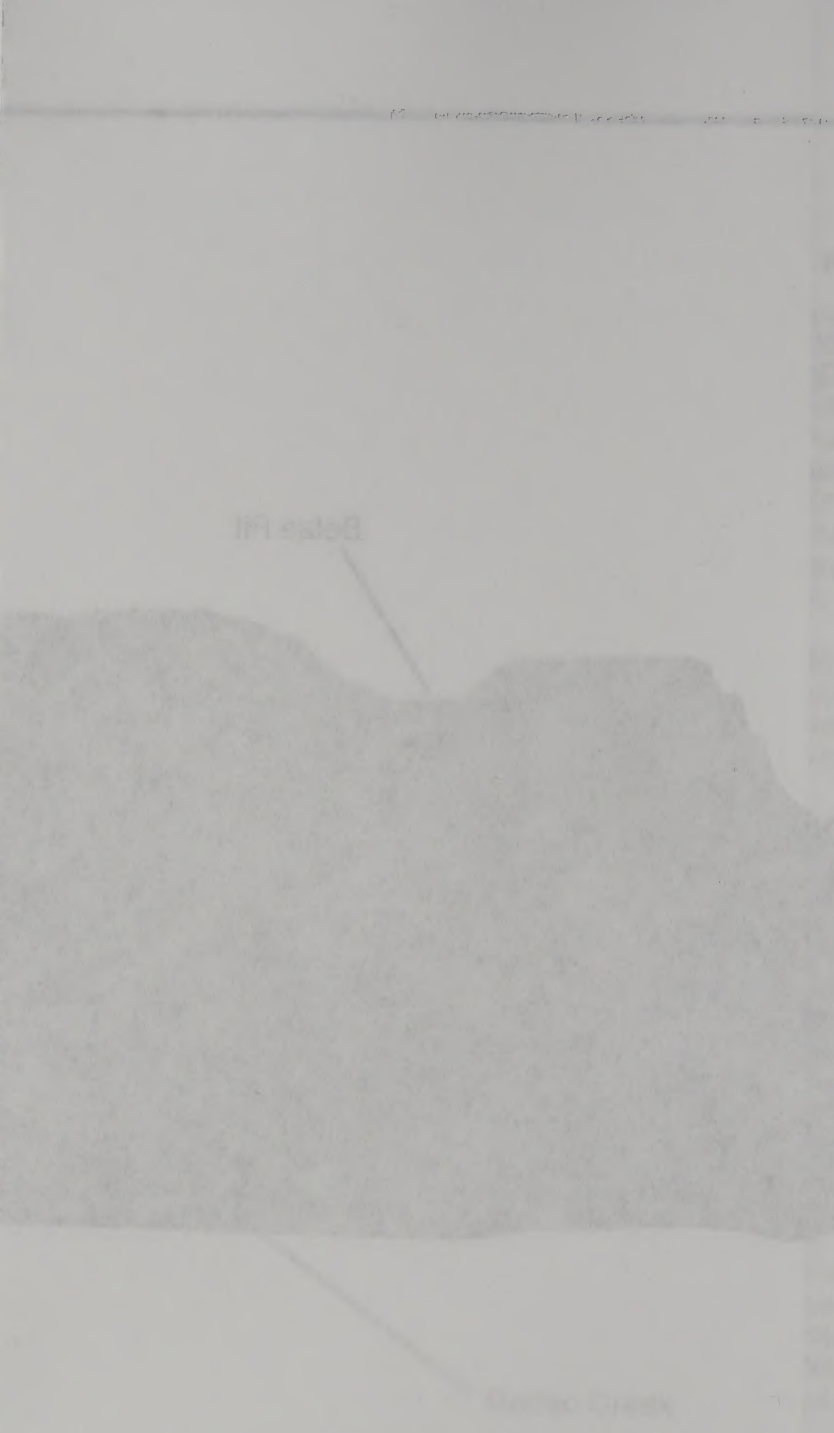


Source: BGMI 2008a.

Betze Pit Expansion Project

Figure 2-16

Proposed Action
Post-mining Reclamation
Topography



placement, and seeding of the remaining portion of the proposed Clydesdale Waste Rock Facility would occur from 2016 to 2018. The Goldstrike No. 3 Tailings Facility would continue to operate through 2031. Reclamation and closure of the proposed tailings facility would begin in 2032 and is anticipated to be completed in 2035. Under the Proposed Action, ongoing reclamation of the existing Bazza Waste Rock Facility would be accelerated and be substantially completed by the end of 2011. BGMI has performed reclamation on portions of the Bazza Waste Rock Facility, primarily on the northwest and southern portions of the facility. BGMI would concurrently reclaim the southern end of the facility as waste rock placement in this area is completed.

The initial reclamation work would involve grading and landform construction. This activity would commence where the previous reclamation stopped, moving to the west, around the perimeter of the facility in a clockwise direction. Once the landform is constructed, cover material and growth medium would be placed. If drainage stabilization such as rock or other erosion control measures are deemed appropriate, they would be installed at this time. Seeding of reclaimed areas would usually be performed in the fall to allow seeds to stratify in the soil and be ready for spring emergence.

The general direction of concurrent reclamation following the completion of the perimeter areas would be toward the east, covering the remaining areas which are available for reclamation. The same general sequence of events stated above would occur. Some areas on the facility would not be concurrently reclaimed. These would include several ore stockpiles located on the top of the facility as well as the landfill, lay down yards and associated access roads and powerline corridors. These would be reclaimed when they are no longer needed for active mining and processing. The projected reclamation schedule for the proposed project is shown in **Figure 2-17**.

2.3.7.3 Facility Reclamation

The goals of the reclamation program are as follows:

- Provide a stable post-mining landform that would support defined post-mining land uses;
- Minimize erosion and protect water resources through control of storm water runoff and stabilization of mine facilities;
- Establish post-reclamation surface soil conditions conducive to the regeneration of a stable plant community through stripping, stockpiling, and reapplication of growth media;
- Revegetate disturbed areas with a diversity of plant species in order to establish productive long-term plant communities compatible with post-mining land uses; and
- Maintain public safety by stabilizing or limiting access to landforms that could constitute a public hazard.

Clydesdale Waste Rock Facility

The reclamation goals for the waste rock facilities include stabilizing slopes, ensuring mass stability, shaping the edges to minimize visual impacts, revegetating surfaces, and erosion control. Reclamation of the waste rock facilities would be conducted concurrently with operations, to the extent possible. As areas of the facilities reach their ultimate height and become permanently inactive, the slopes would be regraded. Growth media subsequently would be placed on the prepared surfaces to a minimum depth of approximately 12 inches, and the areas reseeded. To minimize erosion until vegetation has re-established, silt fences, sediment traps, or other appropriate BMPs would be installed.

Reclamation of the proposed Clydesdale Waste Rock Facility would follow the cover design specifications as described in Clydesdale Waste Rock Management Plan (Schafer and Geosystems 2007):

- Use of a layered cover composed of topsoil and Carlin Formation material designed to reduce or eliminate infiltration of water and oxygen;

- Design of a thicker cover system consisting of 24 inches of topsoil and 48 inches of Carlin material placed over PAG cells; and
- Use of a minimum of 12 inches of cover consisting of either topsoil, Carlin Formation material, or a combination of materials for non-PAG areas.

As areas of the Clydesdale waste rock storage facility reach their ultimate configuration and become inactive, the waste rock facility face would be regraded. Once regraded, the surface would be covered with growth media as described above and seeded. The proposed Clydesdale Waste Rock Facility would be constructed in 100-foot lifts with 250-foot step-outs that would allow for an overall post-mining configuration of 2.5H:1V to 2.8H:1V slopes. Waste rock facility closure practices have been recently developed at the Goldstrike Mine that reduce or eliminate infiltration of water and oxygen, and promote long-term geomorphic stability. This design involves:

- Shaping the pile to a geomorphically stable configuration;
- Placing a soil cover that incorporates high water holding capacity and includes capillary breaks to reduce net infiltration; and
- Establishing perennial vegetation to meet post-mining land use objectives.

Goldstrike No. 3 Tailings Facility

The final configuration of the proposed tailings facility would be designed to maximize runoff and minimize infiltration of direct precipitation and ensure long-term containment of the tailings in addition to the reclamation goals identified previously.

As described above, a Final Plan for Permanent Closure would be developed 2 years prior to project closure pursuant to the requirements of the NDEP (NAC 445A.446 and 445A.447). The plan would include tailings closure specifications, including draindown management. A summary of tailings reclamation is presented below.

In the period leading up to closure, the tailings would be deposited to create a contoured surface that drains to the southwest corner of the facility. Following the final deposition of tailings in the impoundment, the tailings would be permitted to consolidate for a short period of time before placing a "store and release" soil cover of 48 to 60 inches of fine-grained low permeability soil. The soil cover would be seeded with native vegetation to stabilize the soil from wind and water erosion. The areas on the soil cover where flows may concentrate would be stabilized using riprap to prevent scour. All associated surface piping, structures, and equipment would be removed, and any related surface disturbance would be recontoured and reseeded. At closure, the downstream slope of the facility would be vegetated to stabilize the slope. Surface water controls would be put in place to ensure the long-term stability of the slope.

Reclamation of the Goldstrike No. 3 Tailings Facility would entail contouring the tails surface during operation to result in the desired beach angle and orientation. Upon completion of tailing deposition, the supernatant solution and any accumulated storm water will continue to report to the drainage system and will either be returned to the process stream or will be collected and evaporated via evaporation or evapotranspiration cells. A non-reactive waste rock layer will be placed over the tailing surface once the tails have consolidated to a density that will support the rock mass and equipment. This rock layer will act as a foundation for placement of a low-permeability store and release ET soil cover and also will act as a hydraulic capillary break, inhibiting wicking of any process solution into the soil cover and vegetation. This soil cover will deter any meteoric water from entering the tails mass. This technology has been successfully used at this mine site for reclamation and closure of a heap leach and waste rock disposal facilities (Zhan et al. 2000; Myers et al. 2001; Schafer et al. 2005; and Zhan et al. 2006) (see Section 2.2.3, Existing Mine Reclamation and Site Closure Plans). These covers have historically provided excellent winter range for wildlife (**Figures 2-18** and **2-19**).

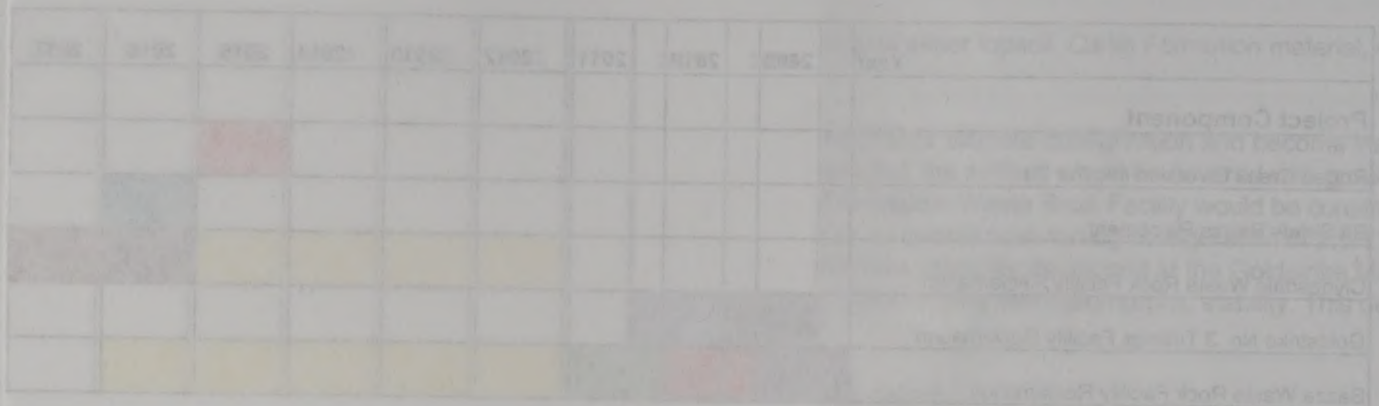
Year	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Project Component															
Rodeo Creek Diversion into the Pit															
Pit Safety Berms Placement															
Clydesdale Waste Rock Facility Reclamation															
Goldstrike No. 3 Tailings Facility Reclamation															
Bazza Waste Rock Facility Reclamation															

2032	2033	2034	2035	2036	2037	2038	2039	2040

Color Key
Miscellaneous
Recontouring
Growth Media Placement
Seeding
Place Store/Release Cover
Monitoring
Interim Solution Management
Short-term Solution Management

Source: BGMI and SRK 2007.

Figure 2-17 Proposed Action Conceptual Reclamation Schedule



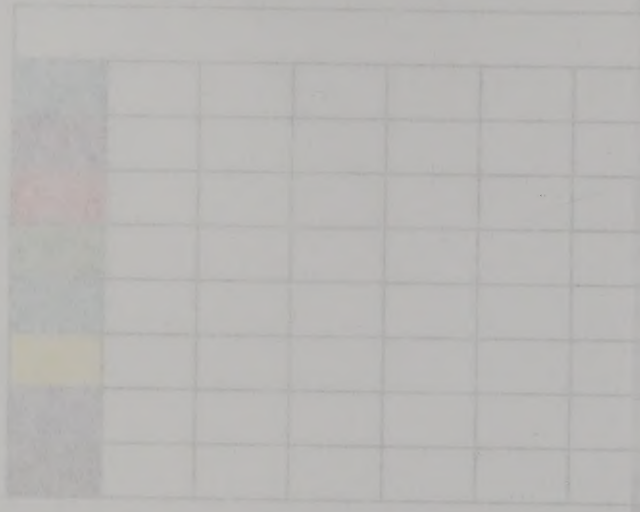




Figure 2-18 Mule Deer Observed on the AA Leach Pad, February 2008



Figure 2-19 Mule Deer Observed on the AA Leach Pad, February 2008

Storm water falling onto this facility would be segregated from the process solution and would be routed through engineered storm water controls and BMPs into the adjacent Brush Creek Diversion channel. This storm water management technique also has been successfully utilized on the AA Heap Leach Facility for over 6 years. (Myer et al. 2001; Schafer and Geosystems 2006). Design modifications were made to the drainage network after an intense thunderstorm on June 1, 2002, delivered an estimated 1.6 inches of total rainfall in 20 minutes at the Goldstrike Mine. This unusual storm event resulted in localized flooding, and caused extensive damage to portions of the drainage channel on the slopes of the AA Leach Pad.

BGMI conducted an investigation of the AA Leach Pad after the storm event and developed some modifications to the drainage channel design to minimize future gullying from intense storm events on mine facilities. Design modifications included an extension of the channel network, increasing channel armour thickness, locating grade control structures at critical points, and modifications to the cross sectional shape of fall line channels. In the fall of 2002, some fall line rock channel segments were reconstructed on the AA Leach Pad due to the damage from the intense storm.

Should the zero-discharge design utilizing evaporation or ET cells prove infeasible at the time of closure, other water management options would be developed in coordination with the BLM and NDEP. These options may include, but would not be limited to:

- Cover redesign to further reduce seepage from meteoric infiltration;
- Enhanced evaporation via mechanical methods (e.g., snow makers, misters, etc.);
- Leach field installation; or
- Water treatment (e.g., precipitation and settling using lime, sulfide, ferrous solution, and/or flocculants, filtration, ion exchange, reverse osmosis, air stripping, biological preparation, or passive wetlands).

The tailings delivered to this facility are planned to be thickened to approximately 50 to 60 percent solid content as compared to conventional tailings with approximately 35 percent solid content. Thickened tailings do not have a large supernatant pond and are not expected to have as long a draindown period as conventionally placed tailings. The draindown curve estimate for the conventional tailings versus thickened tailings is shown in **Figure 2-20**. The tailings disposal facility is conceptually designed with a draindown collection system that will allow the water fraction of the tailings to be collected downstream of the dam.

In addition, passive disposal methods including evaporation or evapotranspiration are planned for this facility. This would be facilitated in lined, approved ponds which would be located on private land, down gradient of the proposed tailings dam.

Final Pit

The objective of mine pit reclamation is to create safe and stable topographic features. Following the completion of mining, in-pit benches, highwalls, and haul roads would be left in place. Post-mining safety barriers (e.g., berms or other appropriate barriers) would be installed peripherally to the crest of the Betze Pit (based on predicted wall stability at the time of closure) to control access by people, livestock, and most wildlife. Pit ramps would be barricaded to deter access.

At the end of mining, after dewatering operations cease, groundwater would begin a recovery period and enter the pit, ultimately resulting in the formation of a pit lake. Implementation of interim revegetation of in-pit waste rock during this recovery period would be completed to the extent practicable (BGMI and SRK 2007).

The proposed disturbance would be reclaimed in accordance with the approved reclamation and closure plan (Schafer and Geosystems 2007). The open-pit floors and ramps are expected to be competent rock surfaces that would be stable without reclamation. These areas would have little or no potential to support vegetation, and future conditions of the pits are not conducive to grazing or terrestrial wildlife habitat.

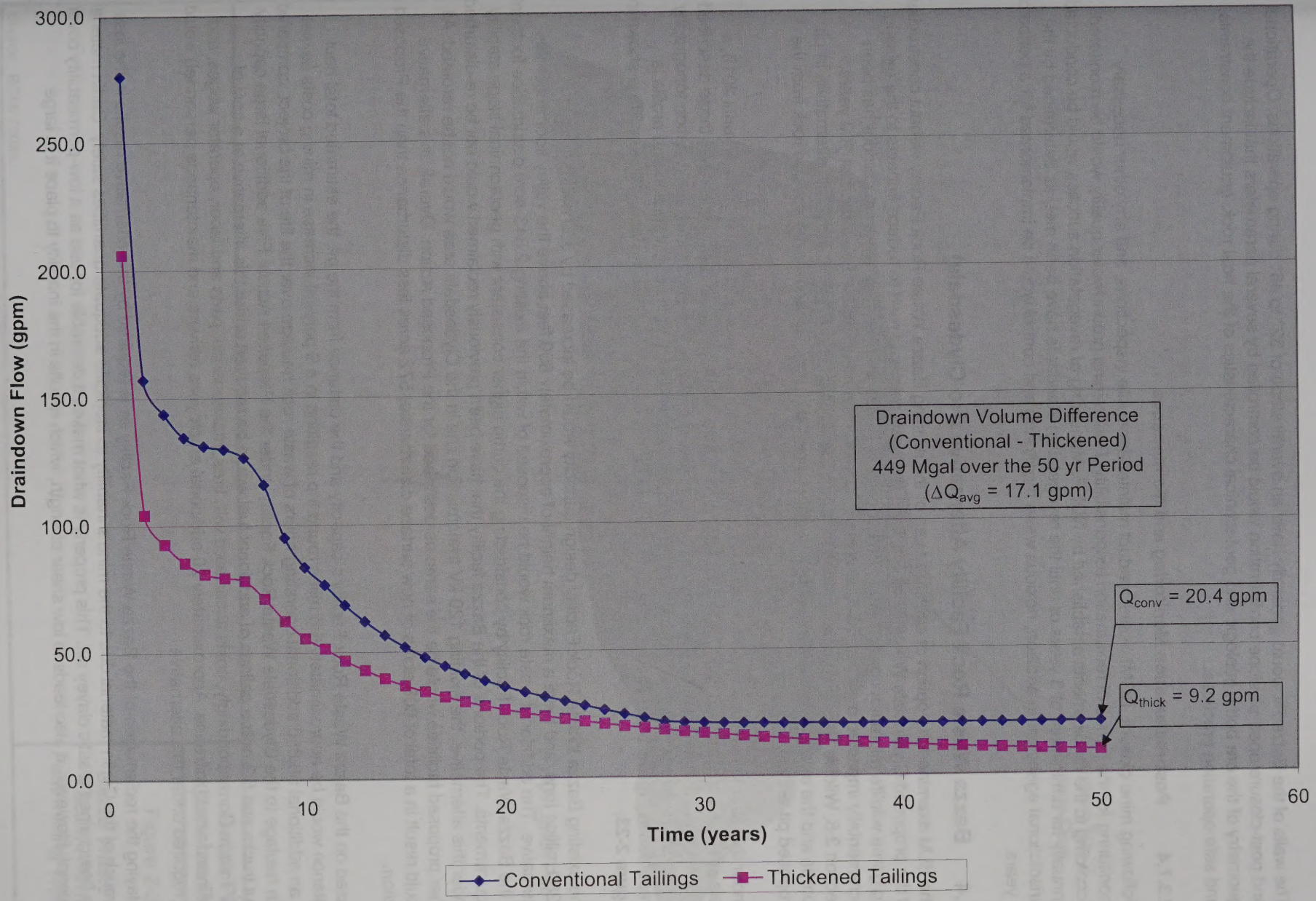


Figure 2-20 Goldstrike No. 3 Tailings Draindown Curve Comparison for Thickened Tailings

Source: Zhan 2008.

The walls of the Betze Pit would generally have an overall slope of 32° to 46° during operations. Operational and post-closure open-pit slope configuration would be controlled by several parameters that include the geometry of the ore body, geologic and geotechnical characteristics of the host rock, equipment constraints, and safe operating practices.

2.3.7.4 Post-reclamation Monitoring and Maintenance

Following mine closure, BGMI would conduct maintenance, site inspections, and any other necessary monitoring for the period of reclamation responsibility. Post-mining groundwater quality would be monitored according to the requirements established by NDEP. Monitoring of revegetation success would be conducted annually for a minimum of 3 years or until the revegetation standards have been met, as determined by the jurisdictional agencies. In addition, noxious weed monitoring and control would be implemented for a period of 5 years.

2.4 Bazza Waste Rock Facility Alternative (No Clydesdale)

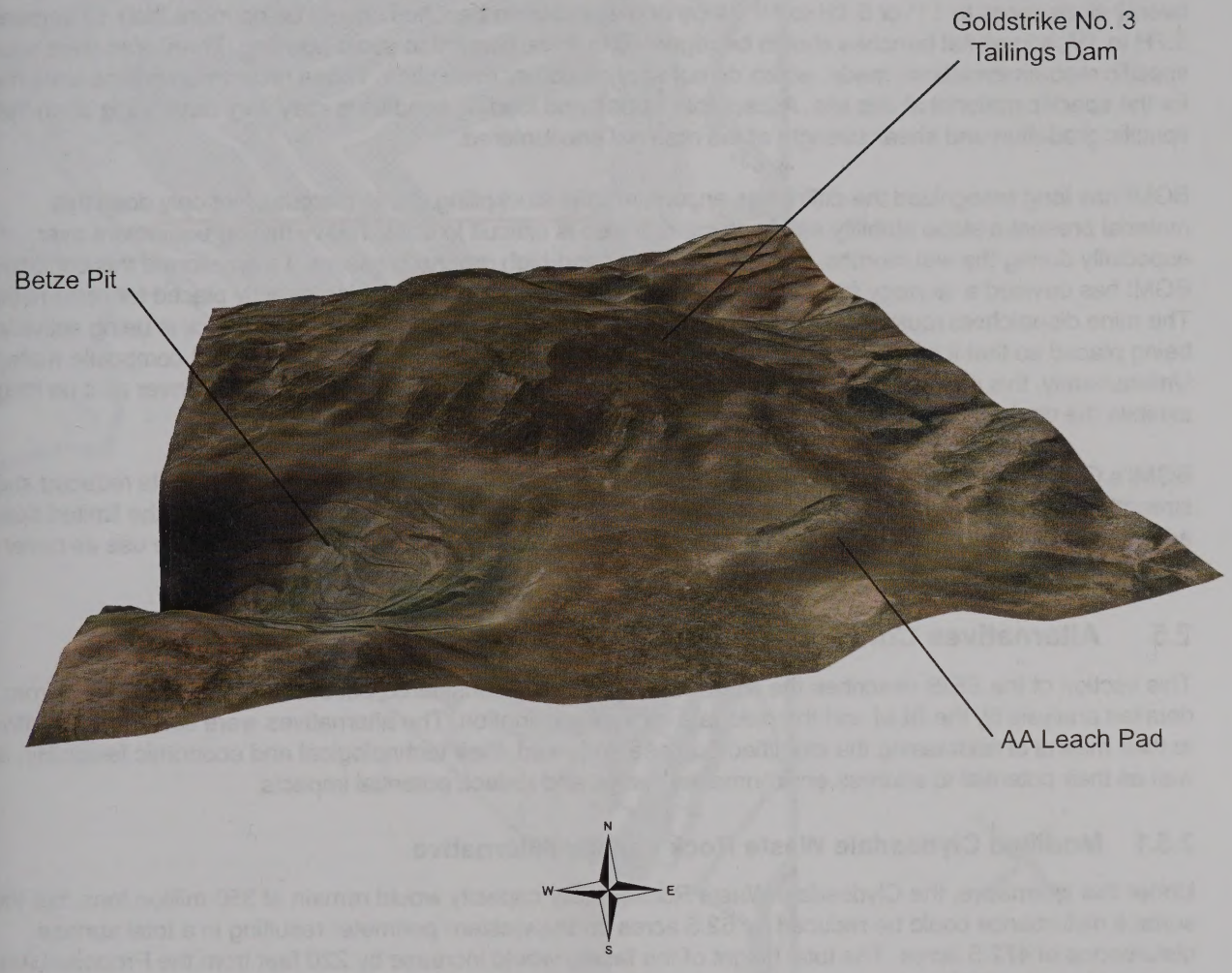
The BLM examined the option of continued use of the existing Bazza Waste Rock Facility without construction of the proposed Clydesdale Waste Rock Facility and Clydesdale haul road to reduce impacts to the existing big game wildlife migration corridor along Bell and lower Rodeo creeks. This migration corridor has been incrementally impacted over time as mining in the Carlin Trend has increased over the last 100 years. Section 3.8, Wildlife Resources, provides more detailed migration information. Under this alternative, in-pit dumps and the existing Bazza Waste Rock Facility would be used as a repository for waste rock from the proposed pit expansion.

Under this alternative, reclamation of the Bazza Waste Rock Facility would not be completed until 2018, a delay of 7 years compared with the Proposed Action. Reclamation procedures would parallel those described in Section 2.2.3, Existing Mine Reclamation and Site Closure Plans. The post-mining reclamation topography for this alternative is shown in **Figure 2-21**. The Bazza Waste Rock Facility cross-section and profile is presented in **Figure 2-22**. The reclamation schedule for the Bazza Waste Rock Facility Alternative is shown in **Figure 2-23**.

The existing Bazza Waste Rock Facility design capacity would be increased by 350 million tons to 2,280 million tons, and have a maximum height of approximately 800 feet above the valley floor under this alternative. The additional waste rock would be disposed of within the existing 2,843-acre disturbance footprint of the Bazza Waste Rock Facility by constructing the dump higher consistent with geotechnical slope stability requirements. The portions of the Bazza facility that have been previously reclaimed would not be re-disturbed. Under this alternative, the existing 120-kV transmission line in the Clydesdale area would not be rerouted. All other proposed facilities would be the same as described for the Proposed Action. Overall, this alternative would result in a total of 608 acres of new surface disturbance, 572 acres less disturbance than the Proposed Action.

Based on the Bazza Waste Rock Facility's capacity and the distance from the pit, the estimated total haul distance would be approximately 6.6 miles round trip resulting in a 9 percent increase in mining costs as well as an additional 58,850 additional operating hours of waste rock haulage over the life of the project, compared with haulage to the Clydesdale Waste Rock Facility under the Proposed Action. Five additional large capacity haul trucks and 5.3 millon gallons of additional fuel would be required under this alternative at a cost of $27 millon. Correspondingly, costs associated with tires, maintenance, parts and labor, operator wages, and overhead would increase. Approximately 20 additional employees (drivers and maintenance personnel) would be required under this alternative.

Delaying the reclamation of the Bazza Waste Rock Facility as is required by this alternative results in the loss of much of the Carlin material due to the mine's inability to stockpile adequate quantities safely. Carlin material is a fine-grained plastic clayey silt. This property is what makes it desirable for use as a low-permeability cover material. However, it also leads to low shear strength, which results in the inability to place it in large



Betze Pit Expansion Project

Figure 2-21

Bazza Waste Rock Facility Alternative Post-mining Topography

Source: BGMI 2008a.

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stockpiles because of the risk of potential slope failure. This type of failure potentially can result in property damage, injury, or death if it occurs where equipment or personnel are present. This type of failure due to Carlin material was seen at the nearby Newmont Gold Quarry Mine on February 2, 2005, when approximately 10 million tons of waste rock material collapsed. The toe of this collapse moved laterally approximately 600 feet before coming to rest. The slide blocked State Route (SR) 766, a power line was damaged, and mine electrical power was lost. A blue ribbon taskforce was assembled by NDEP to determine the cause of the failure and to formulate a corrective action (Call and Nicholas 2006; http://ndep.nv.gov/bmrr/gold_quarry05.htm). Long-term recommendations for the particular material encountered at this site were to grade overall slope faces to 11° or 5.1H to 1V, slope angles between benches should be no more than 15 degrees or 3.7H to 1V, and all flat benches should be regraded to three percent to avoid ponding. There also were site-specific recommendations made, which do not apply on other mine sites. These recommendations were made for the specific material at this site. Acceptable slopes and loading conditions may vary depending upon the specific gradation and shear strength of the material encountered.

BGMI has long recognized the difficulties encountered in stockpiling Carlin material. Not only does this material present a slope stability safety concern, it also is difficult to traffic heavy mining equipment over, especially during the wet months, due to their weight and high ground pressure. To ameliorate this condition, BGMI has devised a strategy for managing Carlin material when it is not being directly placed for reclamation. The mine dispatchers route the Carlin-laden haul trucks to an area where other waste rock is being actively being placed so that it can be mixed, resulting in a higher shear strength, more competent composite material. Unfortunately, this results in a material which cannot be reused for growth medium or ET cover as it no longer exhibits the desired properties needed for this application.

BGMI's Goldstrike Mine also has a self imposed height limitation for Carlin stockpiles due to its reduced shear strength. Stockpiles are held to a maximum of 50 feet in height. This restriction coupled with the limited space available for stockpiling Carlin, severely limits the overall quantity that can be stored for future use as cover and growth medium.

2.5 Alternatives Considered but Eliminated from Detailed Analysis

This section of the SEIS describes the alternatives previously considered but subsequently eliminated from detailed analysis by the BLM and the rationale for their elimination. The alternatives were considered relative to their means of addressing the identified purpose and need, their technological and economic feasibility, as well as their potential to address environmental issues and reduce potential impacts.

2.5.1 Modified Clydesdale Waste Rock Facility Alternative

Under this alternative, the Clydesdale Waste Rock Facility capacity would remain at 350 million tons, but the surface disturbance could be reduced by 62.5 acres on the western perimeter resulting in a total surface disturbance of 472.5 acres. The total height of the facility would increase by 220 feet from the Proposed Action to a total height of 720 feet.

This alternative was reviewed to determine whether there were any benefits to affected resources, particularly to wildlife that might utilize the migration corridor along Bell and Rodeo creeks. Based on the size and location of the 62.5-acre undisturbed area, BLM has concluded that this alternative would not provide any benefits to affected resources, including the mule deer migration corridor, compared with the Proposed Action. In addition, the additional haulage requirements to place waste in this higher dump would require an additional fuel consumption of 5.6 million gallons and a total additional mining cost of approximately $17.5 million dollars. As a result, this alternative was eliminated from further detailed analysis.

2.5.2 Offsite Waste Rock Facility

A new waste rock facility could potentially be located outside the Goldstrike Mine boundary at another location to minimize the impact on the existing wildlife migration corridor along Bell and Rodeo creeks. This alternative



LEGEND

- Cross Section
- Streams
- Retention Ponds

Source: BGMI and SRK 2007; BGMI 2007a.

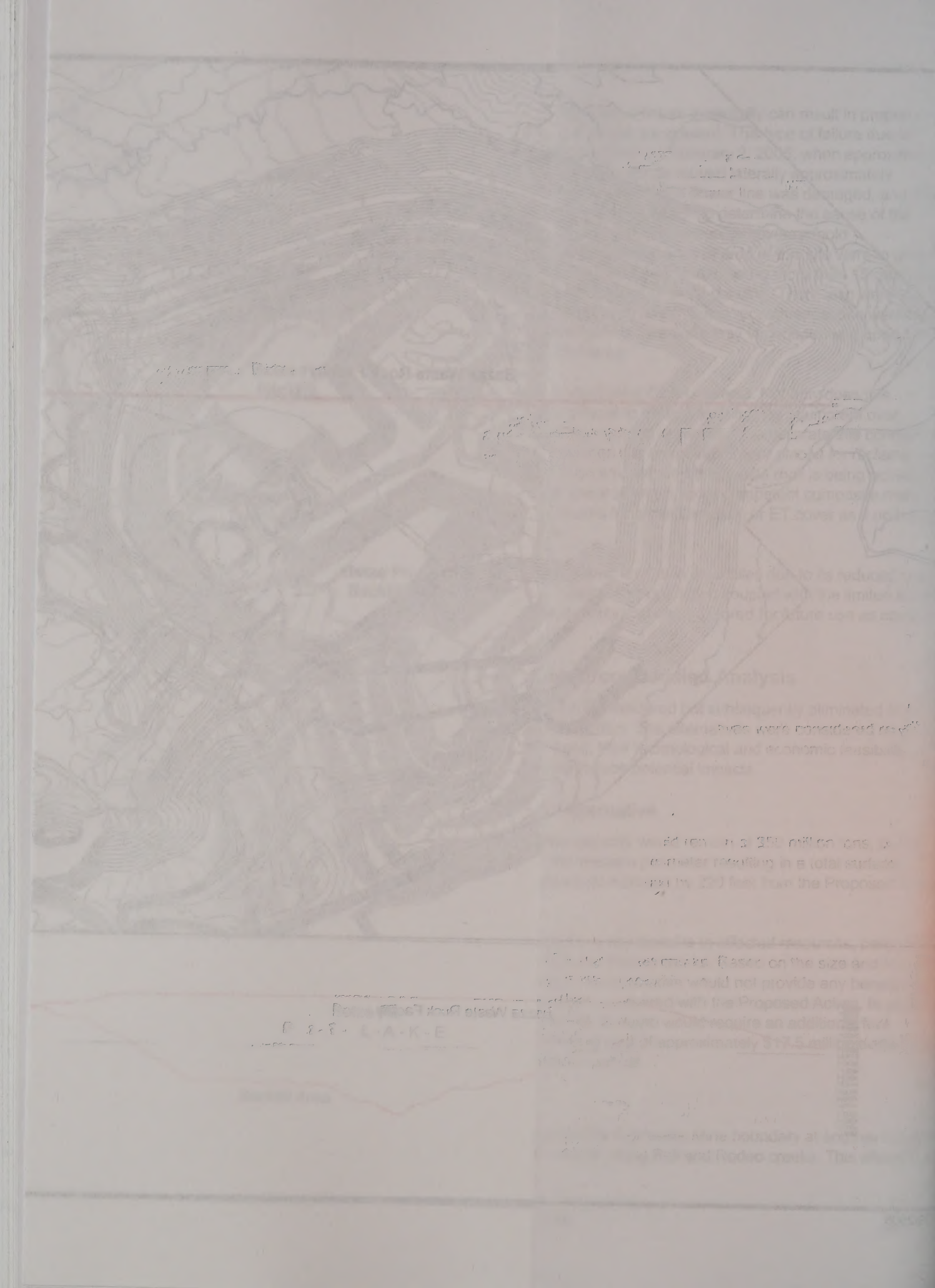
0 0.25 0.5 Miles



Betze Pit Expansion Project

Figure 2-22

Bazza Waste Rock Facility Alternative Cross-section and Profile



Year	2008	2009	2010	1011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Project Component																
Rodeo Creek Diversion into the Pit																
Pit Safety Berms Placement																
Bazza Waste Rock Facility Reclamation																
Goldstrike No. 3 Tailings Facility Reclamation																

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Project Component																
Rodeo Creek Diversion into the Pit																
Pit Safety Berms Placement																
Bazza Waste Rock Facility Reclamation																
Goldstrike No. 3 Tailings Facility Reclamation																

Color Key
Miscellaneous
Waste Rock Placement
Recontouring
Growth Media Placement
Seeding
Place Store/Release Cover
Monitoring
Interim Solution Management
Short-term Solution Management

Source: BGMI and SRK 2007; BGMI 2008a.

Figure 2-23 Bazza Waste Rock Facility Alternative Reclamation Schedule

was eliminated from further detailed analysis because of administrative issues associated with location of a facility outside of the mine boundary potentially on public land, and the associated environmental and economic impacts; a longer haul road would cause greater environmental impacts due to increased land disturbance, air quality degradation, and higher costs of transporting waste rock.

2.5.3 Underground Mining Alternative

Ore potentially could be extracted using underground mining methods rather than open-pit methods that require laybacks. Underground mining would reduce the amount of tailings and waste rock, produced, thus making it possible to reduce the size of the proposed Clydesdale Waste Rock Facility as well as reducing the volume of haul road traffic.

The ore grades in the proposed pit laybacks average less than 0.13 ounce per ton. Underground mining is not economically feasible for gold ore grades less than 0.25 ounce per ton. In contrast, open-pit ore cut off grades for economic feasibility are on the order of 0.05 ounce per ton. Other factors that affect the method and cost of mining an ore reserve include continuity of the mineralized material, depth to mineralization, and volume of material to be mined. The mineralized zone in the proposed pit expansion area meets economic reserve requirements for open-pit mining in part due to the fact that it is an expansion and therefore has a significant amount of waste stripping already accounted for by the current open-pit mining.

The Underground Mining Alternative was eliminated from further consideration because of the relatively low grade of ore reserve present in the proposed layback zone and higher costs associated with this alternative. It is not economically feasible to mine the entire deposit using underground mining methods.

2.5.4 Reduced Tailings Facility Alternative

This alternative would result in constructing a smaller Goldstrike No. 3 Tailings Facility that would affect only private land owned by BGMI. Under this alternative, a total of 644 acres would be disturbed to construct the facility, thereby reducing the amount of surface disturbance by 46 acres compared with the Proposed Action, and thus reducing the capacity of the facility. The reduction in size of the tailings storage facility under this alternative would result in the need for additional tailings storage capacity in another facility, either the existing North Block Tailings Facility, the AA Tailings Facility, or construction of another new facility. Although BGMI could implement this option, the Reduced Tailings Facility Alternative does not provide any environmental benefits compared with the Proposed Action and would be more costly to implement. As a result, this alternative was eliminated from further consideration.

2.6 Comparative Analysis of Alternatives

Table 2-12 summarizes and compares the environmental impacts between the Proposed Action, the Bazza Waste Rock Facility Alternative, and the No Action Alternative. Detailed descriptions of impacts are presented in Chapter 3.0, Affected Environment and Environmental Consequences. The summarized impacts assume the implementation of applicant-committed environmental protection measures but the absence of potential BLM recommended mitigation measures. Implementation of the monitoring and mitigation measures identified in Chapter 3.0 potentially would further reduce impacts.

2.7 BLM-preferred Alternative

The BLM has selected a preferred alternative based on the analysis in this SEIS. This preferred alternative is the alternative that best fulfills the agency's statutory mission and responsibilities, considering economic, environmental, technical, and other factors. The BLM has determined that the preferred alternative is the Proposed Action as outlined in Chapter 2.0 with mitigation measures specified in Chapter 3.0 of this SEIS.

The Proposed Action includes an expansion of the Betze Pit to include a small acreage of public land, construction of the Goldstrike No. 3 Tailings Facility, construction of the Clydesdale Waste Rock Facility, with

modifications to maximize the width of the mule deer migration corridor during mining operations, accelerated reclamation of the Bazza Waste Rock Facility, and continued use of other public lands within the operating area for the additional 4 years of operations. The Proposed Action also means continued employment for 4 additional years for about 1,600 employees of the Goldstrike Mine along with related socioeconomic benefits and impacts. The Proposed Action also includes a number of ancillary actions such as rerouting of 2,000 additional feet of powerline.

The Proposed Action would provide greater beneficial social and economic impacts (see Section 3.12, Social and Economic Values) relative to an extension of mine employment, expenditures, and tax revenues by 4 years compared with the No Action Alternative. The Proposal Action would maximize use of in-pit Carlin material, a valuable growth media and ET cover, to reclaim the Bazza Waste Rock Facility 7 years earlier than the No Action Alternative.

Under the No Action Alternative, the identified mineral resources would not be developed, resulting in the loss of recoverable gold. Most of the Carlin material would be lost and unavailable for reclamation under the No Action Alternative.

Identified impacts under the Bazza Waste Rock Facility Alternative generally would be similar to the Proposed Action with the following exceptions. The Bazza Waste Rock Facility Alternative would eliminate impacts associated with construction of the Clydesdale Waste Rock Facility and not reduce the width of the existing mule deer migration corridor; however, this alternative would result in additional impacts associated with increased waste rock haulage and result in a delay in final reclamation of the Bazza Waste Rock Facility by 7 years when compared with the Proposed Action. The Bazza Waste Rock Facility Alternative would not provide greater environmental benefits than the Proposed Action that includes mitigation to protect the existing mule deer migration corridor.

Table 2-12 Impact Summary and Comparison of the Proposed Action, Bazza Waste Rock Facility Alternative, and No Action Alternative

Resource Areas	No Action Alternative	Proposed Action	Bazza Waste Rock Facility Alternative (No Clydesdale)
Geology and Minerals			
Mineral Extraction and Material Generation and Disposal	BGMI would continue to produce gold from the existing permitted operations for the Betze Project. Gold associated with the Betze Pit Expansion Project would remain in place. The associated waste rock and tailings material would not be generated.	BGMI would remove a total of 12.44 million tons of ore, extract gold, and generate and dispose of approximately 315 million tons of waste rock and 12.44 million tons of tailings material.	Impacts would be the same as the Proposed Action.
Geotechnical and Seismic Stability of Waste Rock and Tailings Facilities	No new waste rock or tailings facilities would be developed.	Facilities would be stable with appropriate design, construction, operation, and closure.	Impacts would be the same as the Proposed Action.
Pit Slope Stability	There is some potential for localized pit slope failure in the Betze Pit during the post-mining period.	Impacts are the same as the No Action Alternative.	Impacts would be the same as the Proposed Action.
Dewatering-induced Subsidence and Earth Fissure Hazards	Subsidence or risk of earth fissure development associated with the continuation of mine dewatering through 2015 is low.	There would be no direct impacts associated with the Proposed Action. There would be a slightly larger area subject to dewatering-induced subsidence due to a slightly larger cone of depression.	Impacts would be the same as the Proposed Action.
Future Availability of Mineral Resources	Identified mineral resource associated with the proposed project would remain in place.	The availability would be reduced by the amount of gold to be mined under the Proposed Action.	Impacts would be the same as the Proposed Action.
Alteration of Topographic or Geomorphic Features	Additional alteration of geomorphic and topographic features would be avoided as proposed facilities would not be developed.	Proposed pit laybacks, reclaimed Clydesdale Waste Rock Facility, and tailings impoundment would result in the permanent alteration of topographic or geomorphic features on approximately 1,143 acres.	The permanent alteration of geomorphic and topographic features (proposed pit laybacks and Goldstrike No. 3 Tailings Facility) would occur on approximately 608 acres.

Table 2-12 Impact Summary and Comparison of the Proposed Action, Bazza Waste Rock Facility Alternative, and No Action Alternative

Resource Areas	No Action Alternative	Proposed Action	Bazza Waste Rock Facility Alternative (No Clydesdale)
Groundwater and Surface Water Resources			
Dewatering and Drawdown	Groundwater will be pumped through 2015. Drawdown would continue in Boulder Valley.	Because no additional dewatering is proposed, there would be no direct impacts associated with the Proposed Action. There would be a slightly larger maximum cone of depression due to a slower rebound in groundwater levels, and a slightly larger permanent cone of depression due to a larger pit lake, in comparison to pre-mining water levels.	Impacts would be the same as the Proposed Action.
Drawdown Effects on Perennial Streams and Springs	No additional impacts that were not previously identified as direct, indirect, or cumulative impacts in the Betze Final SEIS (BLM 2003a).	There would be no direct impacts associated with the Proposed Action.	Impacts would be the same as the Proposed Action.
Drawdown Effects on Water Rights	There would be no additional groundwater rights affected compared to the effects identified in the Betze Project Final SEIS (BLM 2003a).	There would be no direct impacts associated with the Proposed Action.	Impacts would be the same as the Proposed Action.
Pit Lake Development	A pit lake of approximately 803 acres in area would develop in the Betze Pit at steady state.	A pit lake of approximately 927 acres would develop in the Betze Pit at steady state.	Impacts would be the same as the Proposed Action.
Pit Lake Water Quality	Predicted pit lake water quality at equilibrium would have an alkaline pH (7.7) and the following representative constituent concentrations: total dissolved solids (<2,000 milligrams per liter [mg/L], sulfates (1,017 mg/L), arsenic (0.051 mg/L), nickel (1.23 mg/L), cadmium (0.037 mg/L), and selenium (0.007 mg/L).	A slightly larger pit lake would develop with slightly higher constituents such as total dissolved solids, sulfate, and trace metals.	Impacts would be the same as the Proposed Action.

Table 2-12 Impact Summary and Comparison of the Proposed Action, Bazza Waste Rock Facility Alternative, and No Action Alternative

Resource Areas	No Action Alternative	Proposed Action	Bazza Waste Rock Facility Alternative (No Clydesdale)
Groundwater and Surface Water Resources (Continued)			
Water Quality Impacts Associated with Waste Rock and Tailings Facilities	There would be no impacts to groundwater or surface water quality.	There would be no impacts to groundwater or surface water quality.	There would be no impacts to groundwater or surface water quality.
Flooding	The Rodeo Creek Diversion from north of the Betze Pit to south of the pit would result in no impacts to the conveyance capacity of the 100-year floodplain.	There would be no impacts to the conveyance capacity of the 100-year floodplain.	There would be no impacts to the conveyance capacity of the 100-year floodplain.
Soils and Reclamation			
General Soils Impacts	Additional impacts to soils would be avoided as the proposed ground disturbance would not occur; however, most of the Carlin material from current authorized mining activities would be lost and unavailable as a growth medium.	Approximately 1,180 acres of soils would be disturbed with 129 acres of soils not reclaimed. Suitable topsoil and growth media would be salvaged and stockpiled during ground-disturbing activities for reclamation purposes. There would be long-term reductions in soil productivity in areas being reclaimed. Areas within the pit that would not be reclaimed would have permanent loss of productivity. There could be additional soil losses resulting from erosion due to project activities. Carlin material would be available as a reclamation cover.	Impacts would be similar to the Proposed Action, except approximately 608 acres of soils would be disturbed under this alternative, with 129 acres of soils not reclaimed. In addition, there would be a loss of the Carlin material as an effective reclamation cover.

Table 2-12 Impact Summary and Comparison of the Proposed Action, Bazza Waste Rock Facility Alternative, and No Action Alternative

Resource Areas	No Action Alternative	Proposed Action	Bazza Waste Rock Facility Alternative (No Clydesdale)
Vegetation			
Upland Vegetation	There would be no additional impacts to vegetation as no new disturbance would occur. However, the loss of Carlin material would negatively affect vegetation recovery and reclamation of the Bazza Waste Rock Facility as the Carlin material supports a healthy vegetative cover, that exceeds reclamation requirements. Substitute materials including waste rock, provide only adequate vegetative cover.	The proposed mine expansion would disturb or remove approximately 1,180 acres of vegetation, the majority of which subsequently would be reclaimed. Areas within the Betze Pit expansion (approximately 129 acres) that would not be reclaimed would have a permanent loss of vegetation. Carlin material would be available to improve vegetation recovery of disturbed areas.	Impacts would be similar to the Proposed Action, except that: 1) approximately 608 acres of vegetation would be disturbed, of which all but 129 acres would be reclaimed; and 2) loss of effective use of Carlin material as an effective growth medium.
Wetland and Riparian Areas	No additional impacts that were not previously identified as direct, indirect, or cumulative impacts in the Betze Final SEIS (BLM 2003a).	There would be no direct impacts associated with the Proposed Action.	Impacts would be the same as the Proposed Action.
Special Status Plant Species	No additional impact to special status plant species or their habitat would occur.	No impacts to special status plant species would occur.	No impacts to special status plant species would occur.
Wildlife and Aquatic Resources			
Wildlife Habitat	No additional wildlife habitat would be disturbed.	Approximately 943 acres of terrestrial habitat (native vegetation) would be disturbed, of which approximately 101 acres of terrestrial habitat would not be reclaimed. Surface disturbance would result in a temporary incremental increase in habitat fragmentation and displacement until vegetation has been re-established.	Approximately 565 fewer acres of terrestrial habitat (native vegetation) would be disturbed.

Table 2-12 Impact Summary and Comparison of the Proposed Action, Bazza Waste Rock Facility Alternative, and No Action Alternative

Resource Areas	No Action Alternative	Proposed Action	Bazza Waste Rock Facility Alternative (No Clydesdale)
Wildlife and Aquatic Resources (Continued)			
Mule Deer	No additional mule deer migration corridors or seasonal range would be disturbed.	Approximately 943 acres of low density mule deer habitat would be disturbed, of which approximately 101 acres would not be reclaimed. Approximately 565 acres of an important mule deer migration corridor would be directly impacted.	Approximately 378 acres of low density mule deer habitat would be disturbed, of which approximately 101 acres would not be reclaimed. No impacts would occur to an important mule deer game migration corridor.
Pronghorn	No additional pronghorn range would be disturbed.	Approximately 426 acres of pronghorn range would be disturbed. Approximately 360 acres of crucial pronghorn winter range would be directly impacted. However, impacts to pronghorn populations are anticipated to be low.	Approximately 205 acres of pronghorn range would be disturbed. No direct impacts would occur to crucial pronghorn winter range.
Impacts to Breeding Birds	No additional impacts to habitat; ongoing operations and reclamation would continue to impact habitat in existing disturbance areas. No additional impacts to breeding birds, including raptor and passerine species, would occur.	Direct impacts to bird species would include the temporary loss of approximately 943 acres, and the permanent loss of approximately 101 acres of potentially suitable breeding, roosting, and foraging habitat. Potential direct impacts (i.e., loss of nests, eggs, or young) to breeding birds would be minimized by vegetation clearing outside of the breeding season, to the extent possible, and the implementation of breeding bird surveys and appropriate mitigation, as needed, in coordination with BLM and NDOW.	Impacts would be the same as the Proposed Action, except approximately 565 fewer acres of breeding bird habitat would be disturbed.
Impacts to Invertebrates	No additional impacts that were not previously identified as direct, indirect, or cumulative impacts in the Betze Final SEIS (BLM 2003a).	No impacts to invertebrates would occur.	No impacts to invertebrates would occur.

Table 2-12 Impact Summary and Comparison of the Proposed Action, Bazza Waste Rock Facility Alternative, and No Action Alternative

Resource Areas	No Action Alternative	Proposed Action	Bazza Waste Rock Facility Alternative (No Clydesdale)
Wildlife and Aquatic Resources (Continued)			
Fisheries Habitat	No additional perennial stream habitat would be disturbed. The Rodeo Creek Diversion from north of the Betze Pit to south of the pit would result in a reduction of approximately 1.5 miles of intermittent stream habitat.	No project-related disturbance would occur within perennial stream habitat.	Impacts would be the same as the Proposed Action.
Noise and Human Presence	These impacts would remain the same as current levels until ongoing operations and reclamation have been completed, at which time these impacts would end.	Impacts would be extended for 4 additional years.	Impacts would be the same as the Proposed Action.
Water Quantity and Quality	Potential impacts to wildlife habitat associated with existing approved water management operations would continue. There would be no new potential impacts to wildlife from cyanide ingestion.	No wetland or riparian habitat would be impacted by project disturbance. Based on BGMIs committed environmental protection measures, potential impacts to wildlife from cyanide ingestion would be low.	Impacts would be the same as discussed for the Proposed Action.
Pit Lake Formation	Potential impacts associated with the approved Betze Pit Lake would continue under the No Action Alternative.	Based on the results of groundwater modeling and ecological risk assessment, pit lake water would not pose a chemical risk to wildlife or aquatic resources.	Impacts would be the same as the Proposed Action.
Potential for Hazardous Materials Spill	Hazardous materials used for ongoing processing would continue to be transported to the existing operations.	Impacts would be the same as the No Action Alternative but extended for 4 years.	Impacts would be the same as the Proposed Action.

Table 2-12 Impact Summary and Comparison of the Proposed Action, Bazza Waste Rock Facility Alternative, and No Action Alternative

Resource Areas	No Action Alternative	Proposed Action	Bazza Waste Rock Facility Alternative (No Clydesdale)
Wildlife and Aquatic Resources (Continued)			
Bats	No additional impacts to bat species or their habitat would occur.	The long-term disturbance of foraging habitat, including 867 acres of sagebrush shrubland habitat and permanent loss of 101 acres of sagebrush shrubland habitat would be considered a low impact.	Impacts would be the same as the Proposed Action except approximately 565 fewer acres of habitat would be disturbed.
Impacts to Pygmy Rabbit	No additional impacts to pygmy rabbits or potentially suitable habitat would occur.	The long-term loss of approximately 867 acres and the permanent loss of approximately 101 acres of potentially suitable sagebrush habitat would be considered a low impact. The potential loss of individual rabbits during construction would not result in population-level effects.	Impacts would be the same as the Proposed Action except approximately 565 fewer acres of sagebrush habitat would be disturbed.
Preble's Shrew	No additional impacts to Preble's shrew or potentially suitable habitat would occur.	The long-term reduction of approximately 943 acres and permanent loss of approximately 101 acres of potentially suitable habitat would be considered a low impact. The potential loss of individual shrews during construction would not result in population-level effects.	Impacts would be the same as the Proposed Action except approximately 565 fewer acres of habitat would be disturbed.
Fletcher Dark Kangaroo Mouse	No additional impacts to Fletcher dark kangaroo mouse or potentially suitable habitat would occur.	The long-term loss of approximately 943 acres and permanent loss of approximately 101 acres of potentially suitable habitat would be considered a low impact. The potential loss of individuals during construction would not result in population-level effects.	Impacts would be the same as the Proposed Action except approximately 565 fewer acres of habitat would be disturbed.

Table 2-12 Impact Summary and Comparison of the Proposed Action, Bazza Waste Rock Facility Alternative, and No Action Alternative

Resource Areas	No Action Alternative	Proposed Action	Bazza Waste Rock Facility Alternative (No Clydesdale)
Wildlife and Aquatic Resources (Continued)			
Impacts to Sensitive Bird Species	No additional impacts to the bald eagle, golden eagle, Swainson's hawk, prairie falcon, peregrine falcon, and ferruginous hawk or potentially suitable habitat would occur.	Bald eagle, golden eagle, ferruginous hawk, Swainson's hawk, peregrine falcon, and prairie falcon – no direct impacts to nesting raptors are anticipated; long-term loss of approximately 867 acres of potential foraging habitat; indirect impacts would result from mine-related noise and human presence – potential impacts to these species would be low.	Impacts would be the same as the Proposed Action, except approximately 565 fewer acres of terrestrial habitat (native vegetation) would be disturbed.
Impacts to Greater Sage-grouse	No additional impacts to the greater sage-grouse or potentially suitable habitat would occur.	No impacts to breeding greater sage-grouse would be anticipated; impacts to brooding habitat would be low. Direct impacts associated with project-related habitat reduction (867 acres) would be considered negligible based on the availability of suitable habitat in the project vicinity.	Impacts would be the same as the Proposed Action, except approximately 565 fewer acres of terrestrial habitat (native vegetation) would be disturbed.
Impacts to Short-eared and Long-eared Owl	No additional impacts to the short-eared owl, long-eared owl, or potentially suitable habitat would occur.	Direct impacts associated with project-related habitat reduction (943 acres) would be considered negligible for the short-eared owl and low for the long-eared owl, based on the availability of suitable habitat in the project vicinity. Indirect impacts would result from mine-related noise and human presence.	Impacts would be the same as the Proposed Action, except approximately 565 fewer acres of terrestrial habitat (native vegetation) would be disturbed.
Impacts to Burrowing Owl	No additional impacts to the burrowing owl or potentially suitable habitat would occur.	Direct impacts would include the short-term reduction (pending successful reclamation) of potential shrubland breeding and foraging habitat (943 acres). Indirect impacts would result from mine-related noise and human presence. Potential impacts to	Impacts would be the same as the Proposed Action, except approximately 565 fewer acres of terrestrial habitat (native vegetation) would be disturbed.

Table 2-12 Impact Summary and Comparison of the Proposed Action, Bazza Waste Rock Facility Alternative, and No Action Alternative

Resource Areas	No Action Alternative	Proposed Action	Bazza Waste Rock Facility Alternative (No Clydesdale)
Wildlife and Aquatic Resources (Continued)			
Impacts to Loggerhead Shrike, Vesper Sparrow, and Yellow-breasted Chat	No additional impacts to loggerhead shrike, vesper sparrow, yellow-breasted chat, or potentially suitable habitat would occur.	Loggerhead shrike, vesper sparrow, and yellow-breasted chat - direct impacts associated with project-related habitat reduction (943 acres) and indirect impacts from mine-related noise and human presence would be considered negligible.	Impacts would be the same as the Proposed Action, except approximately 565 fewer acres of terrestrial habitat (native vegetation) would be disturbed.
Cultural Resources			
	Adverse effects to five NRHP-eligible sites were mitigated in accordance with the treatment plan and PA. However, the sites would not be destroyed by project construction.	Adverse effects to five NRHP-eligible sites were mitigated in accordance with the treatment plan and PA. However, the sites ultimately would be destroyed by project construction, and some of their information would be lost.	Impacts would be the same as the Proposed Action.
Native American Traditional Values			
	There would be no impacts to known traditional cultural properties or places of cultural and religious importance. See "Cultural Resources" for impacts to NRHP eligible sites.	To date, none of the tribes participating in consultation have identified any traditional cultural properties, or places of cultural and religious importance in the project area. See "Cultural Resources" for impacts to NRHP-eligible sites.	Impacts would be the same as the Proposed Action.

Table 2-12 Impact Summary and Comparison of the Proposed Action, Bazza Waste Rock Facility Alternative, and No Action Alternative

Resource Areas	No Action Alternative	Proposed Action	Bazza Waste Rock Facility Alternative (No Clydesdale)
Air Quality			
Air Emissions	Impacts to air quality would be limited to ongoing approved mining, mineral processing, and reclamation activities. The modeled concentrations indicate project emissions would comprise a small fraction of the applicable ambient air quality standards.	The extension of mining by 4 years and roaster operations by 5 years would not alter emission rates from current authorized activities. Therefore, results indicate that maximum concentrations of particulate matter with an aerodynamic diameter of 10 microns or less (PM_{10}), nitrogen oxide (NO_x), carbon monoxide (CO), SO_2, and ozone (O_3) would not exceed applicable Nevada or National Ambient Air Quality Standards (NAAQS). There would be no impacts to PSD Class I areas.	Impacts would be similar to the Proposed Action except that additional emissions would be generated due to longer waste rock haul distances required.
Hazardous Air Pollutant Emissions	The combined hazardous air pollutant (HAP) emissions are less than the major source limit of 25 tons per year (tpy); therefore, the No Action Alternative would not constitute a major HAP source.	The combined HAP emissions would be less than the major source limit of 25 tpy; therefore, the Proposed Action would not constitute a major HAP source.	Impacts would be similar to the Proposed Action.
Mercury Emissions	Mercury emissions were estimated 617 pounds per year in 2006 for ongoing approved mining and mineral processing activities. Modeling results indicate that mercury deposition ranges from approximately 10 percent near the mine source to less than 1 percent of the total background deposition of mercury at a distance of 30 to 100 kilometers (km) from the mine source. Mercury emissions are expected to decline with continued implementation of the Nevada Mercury Air Emissions Control Program.	Mineral processing of 12.44 million tons of ore would result in an estimated incremental increase of a total of 625 pounds of mercury over the 5 additional years of roaster operations.	Impacts would be the same as the Proposed Action.

Table 2-12 Impact Summary and Comparison of the Proposed Action, Bazza Waste Rock Facility Alternative, and No Action Alternative

Resource Areas	No Action Alternative	Proposed Action	Bazza Waste Rock Facility Alternative (No Clydesdale)
Social and Economic Values			
Employment and Revenue	Closure of the Betze Pit would require a reduction of the work force beginning in approximately 2011. Nearly all of the current work force would be terminated between 2011 and final closure of the project in 2026.	The work force during construction and operations would remain approximately 1,600 workers for an additional 4 years, through 2015. The local economy would benefit from the resulting continuation of wage and salary payments. State and local government revenues also would benefit. Nearly all of the work force would be terminated between 2016 and final closure of the project in 2031. The work force is not expected to increase due to the Proposed Action.	Impacts would be nearly the same as the Proposed Action with a slight increase in employment necessary due to the extended haul distance.
Population	Changes in area population would be dependent on the availability of alternative employment in the area. Ultimately the area population could decline. Impacts on public infrastructure and services would occur due to reduction in mining force in 2011.	Mining would be extended by 4 years through 2015 with the current work force.	Impacts would be the same as the Proposed Action.
Tax Revenue	Tax revenues would decline between the end of mining in 2011 and complete closure of the project in 2026. There also would be a concurrent decline in tax proceeds.	Tax revenues would be extended by an additional 4 years relative to the No Action Alternative.	Impacts would be similar to the Proposed Action.
Local Infrastructure	Growth pressure on schools, housing, and public services would be reduced beginning in 2011. Potential population declines could lead to under-utilization of schools.	Impacts would be the same as the No Action Alternative, but occurring 4 years later.	Impacts would be the same as the Proposed Action.

Table 2-12 Impact Summary and Comparison of the Proposed Action, Bazza Waste Rock Facility Alternative, and No Action Alternative

Resource Areas	No Action Alternative	Proposed Action	Bazza Waste Rock Facility Alternative (No Clydesdale)
Visual Resources			
	There would be no additional disturbance beyond what currently exists or is currently permitted. The existing management guidelines for Visual Resource Management (VRM) Class IV lands would not be exceeded.	From key observation points (KOPs) #1 and #2, visual contrasts allowable for VRM Class IV lands within the mine site would be met during active mining. Proposed reclamation and revegetation would reduce the long-term visual effects and achieve VRM objectives in the Class IV areas from KOPs #1 and #2.	Visual impacts associated with an increase in height of the Bazza Waste Rock Facility relative to the Proposed Action would be offset in part by not constructing the Clydesdale Waste Rock Facility and haul road.
Hazardous Materials and Solid Waste			
Transportation	Transportation of hazardous materials associated with the existing operations would continue.	Transportation of hazardous materials would be extended up to an additional 5 years with no expected change in quantities transported from existing operations.	Impacts would be similar to the Proposed Action.
Storage and Use	Hazardous materials would continue to be transported, stored, and used at the site at the same rate as current operations until operations begin to wind down and the materials are no longer required.	Storage and use of hazardous materials would be extended up to an additional 5 years with no expected change in quantities stored or used.	Impacts would be similar to the Proposed Action.

AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

CHAPTER 3

3.0 Affected Environment and Environmental Consequences

Introduction

This chapter summarizes the changes in the affected environment and environmental consequences described in the 1991 Betze Project EIS and 2003 Betze Project SEIS for the Proposed Action and alternatives analyzed in this SEIS. It includes a description of the past, present, and reasonably foreseeable future actions (RFFAs) that may result in cumulative impacts with the Proposed Action or alternatives.

The baseline information summarized in this chapter was obtained from published and unpublished materials; discussions with local, state, and federal agencies; from field and laboratory studies conducted in the project area and on-site experience with mining and reclamation. The affected environment for individual resources was delineated based on the area of potential direct and indirect environmental impacts for the proposed project. For resources such as soils and vegetation, the affected area was determined to be the physical location and immediate vicinity of the areas to be disturbed by the proposed project. For other resources such as water quality, air quality, wildlife, social and economic values, the affected environment was more extensive (e.g., airshed, local communities, etc.).

This chapter also describes the anticipated direct and indirect impacts of the Proposed Action and the alternatives as well as potential cumulative impacts. The analysis of potential impacts from the Proposed Action assumed the implementation of the applicant-committed environmental protection measures that would be implemented in association with the proposed project (see Section 2.2.1.13, Applicant-committed Environmental Protection Measures). Mitigation and monitoring developed in response to anticipated impacts are recommended by the BLM for individual resources, and are discussed at the end of each resource section.

The proposed project may result in cumulative effects associated with other past and present actions and RFFAs in the area. For resources where project-specific impacts are identified, the cumulative effects associated with the proposed project were evaluated together with other past and present actions and RFFAs. The period of potential cumulative impact is defined as the approximately 23-year life of the project (4-year extension of mining and 15 years of ore processing plus 4 years for reclamation). The cumulative effects analysis for each resource addressed the potential cumulative effects within resource-specific cumulative effects study areas.

The Proposed Action does not require dewatering of the Betze Pit; therefore, there are no resource impacts from dewatering under the Proposed Action. Pit dewatering impacts were addressed in the Betze Project SEIS (BLM 2000a, 2003a) through Year 2011. The potential impacts associated with dewatering for an additional 4 years, through 2015, from current State of Nevada authorizations for the Meikle underground mine are analyzed under the No Action Alternative. The BLM has no decision-making authority regarding dewatering operations. Impact analysis of dewatering operations under the No Action Alternative is provided to inform the public of the environmental consequences of this action. Dewatering will occur regardless of the alternative selected.

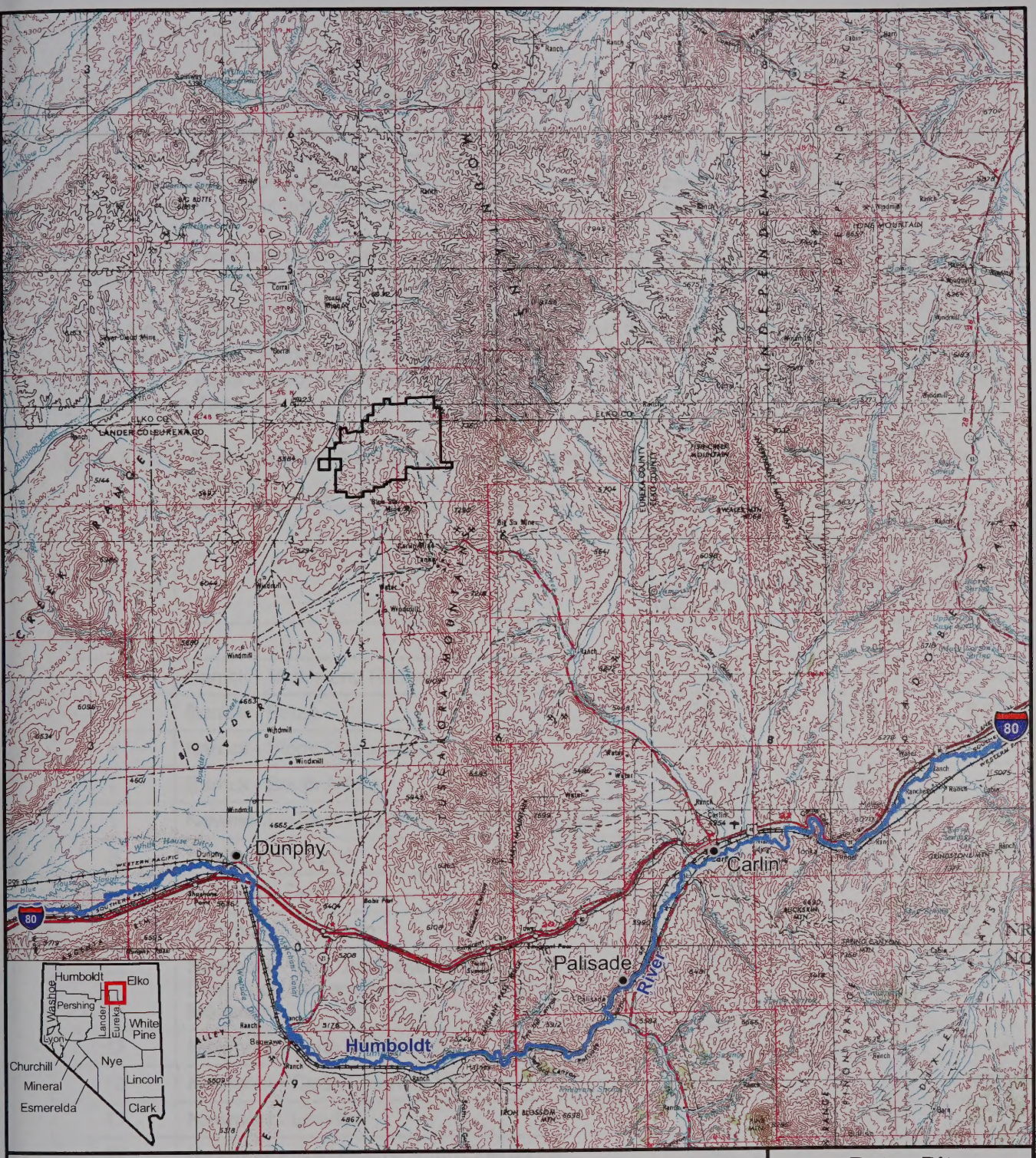
Section 2.2.1, Current Mining Operations or Facilities that will Continue Unchanged, summarizes mine operations including current drilling and blasting; loading and hauling ore and waste rock; ore stockpiling and processing; existing infrastructure and ancillary support facilities; exploration; and safety and fire protection. These activities or facilities are currently authorized under existing operations at the Goldstrike Mine and impacts were previously evaluated in the Betze Project EIS (BLM 1991a,b). These activities or facilities would continue to operate for an additional 4 years under the Proposed Action. There would be no substantive impacts associated with these actions under the Proposed Action that would differ from the alternatives. Therefore, impacts associated with these mining operations or facilities will not be discussed further in this SEIS.

This chapter is organized according to 13 affected resource topics. Subsections for each resource include:

1. Affected Environment
2. Environmental Consequences (of each alternative)
3. Cumulative Impacts
4. Mitigation and Monitoring

General Setting

The Goldstrike Mine is located near the north-central portion of the Great Basin in the Boulder Flat Watershed Subbasin floristic region (**Figure 3.0-1**). The surrounding terrain consists of alternating mountain ranges and sagebrush-covered valleys, with the mine site situated in the Basin and Range physiographic province. This region is characterized by large, extensive valleys located between the Tuscarora Mountain Range to the north of the Boulder Flat and the Sheep Creek Range to the southwest. Elevations at the project location range from approximately 5,500 feet to 7,000 feet amsl. The climate is marked by extreme weather conditions characterized as arid and accompanied by temperatures ranging from -20 degrees Fahrenheit (°F) to more than 100°F. Overall precipitation is very low, with erratic rainfall patterns that tend to be localized.



LEGEND

— Goldstrike Mine Operations Boundary

N

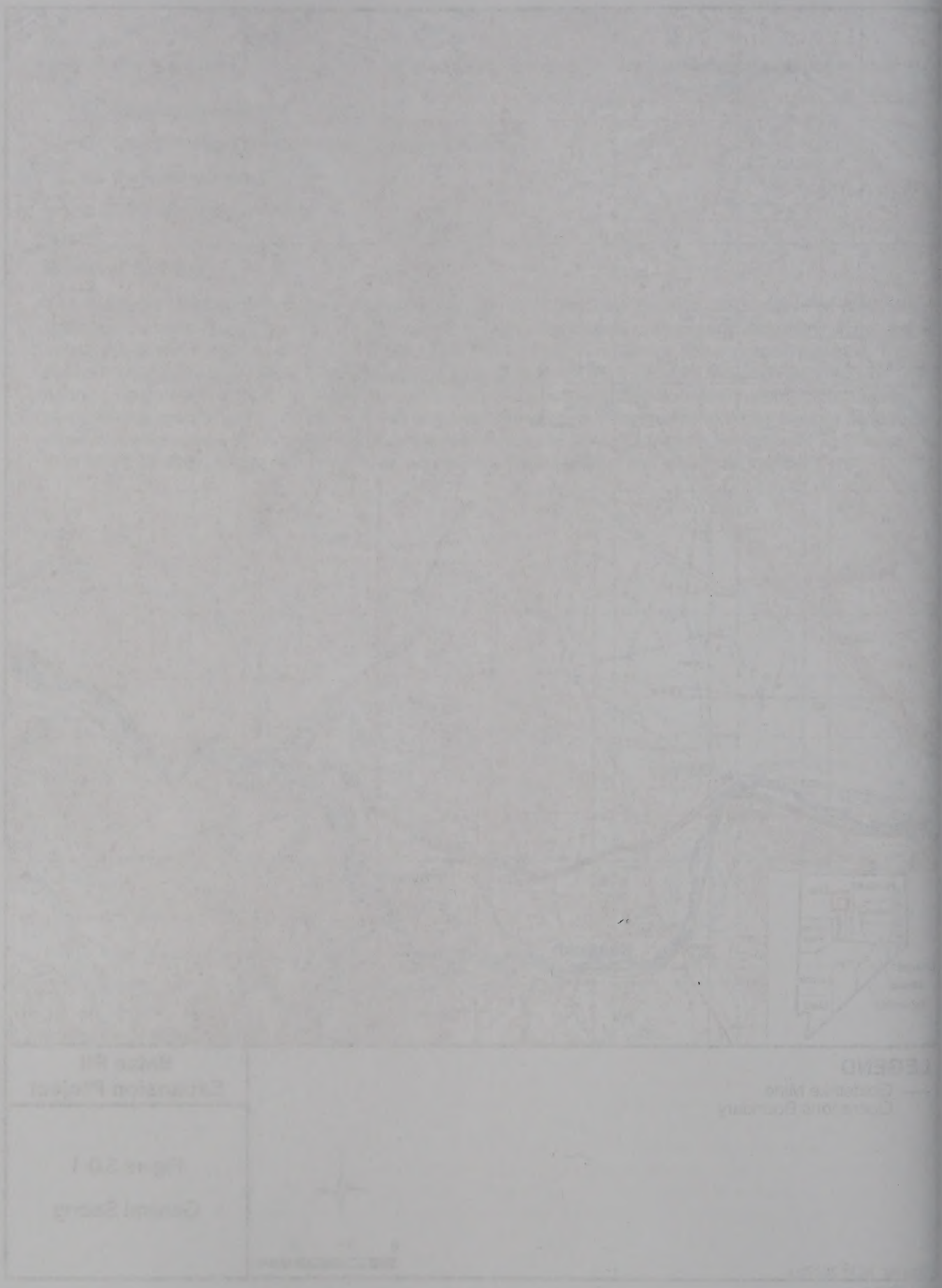
0 2.5 5 Miles

Source: BLM 2007b,c.

Betze Pit Expansion Project

Figure 3.0-1

General Setting



3.1 Past, Present, and Reasonably Foreseeable Future Actions

Cumulative impacts are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and RFFAs regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor, but collectively significant actions taking place over a period of time" (40 CFR 1508.7).

Related projects and actions are defined for the SEIS as those past and present actions and RFFAs that could interact with the Proposed Action or alternatives in a manner that would result in cumulative impacts, resulting primarily from mining, commercial activities, and public uses. The past, present, and RFFAs previously identified in the Betze Project EIS (BLM 1991a,b), Betze Project SEIS (BLM 2000a, 2003a), and the CIA of Dewatering and Water Management Operations for the Betze Project, South Operations Area Project, and Leeville Project (BLM 2000b) have been updated for this analysis. The mining-related surface disturbances are identified in **Table 3.1-1**.

Table 3.1-1 Mining-related Surface Disturbance Associated with Past and Present Actions and RFFAs

Map Reference No.	Action	Past and Present Disturbance (acres)	RFFA Projected Disturbance (acres)	Total Approved/ Projected Disturbance (acres)
Mining Projects				
11	Barrick - Meikle and Rodeo	222	--	222
11	Barrick - Betze	7,882	1,180	9,062
6	Barrick - Storm Underground	185	--	185
7	Barrick - South Arturo	0	100	100
1	Newmont - Great Basin Gold-Hollister/Ivanhoe	268	100	368
3	Halliburton - Rossi	408	300	708
8	Goldcorp - Dee Mine	1,315	--	1,315
10	Newmont - Bootstrap	1,900	--	1,900
12	Newmont - Blue Star/Genesis, Section 36, Deep Star, Lantern, North Lantern, Bullion Monarch	2,797	137	2,934
12	Newmont - North Area Leach	1,526	--	1,526
12	Newmont - Carlin Mine/Mill 1, Pete	3,673	--	3,673
13	Newmont - Leeville	566	--	566
17	Newmont - Gold Quarry/South Operations Area Project (SOAP), MC Reservoir, N-S Haul Road	9,961	--	9,961
19	Newmont - Rain	961	--	961
20	Newmont - Emigrant	0	1,603	1,603
17	Newmont - South Waste Rock Disposal Facility	0	100	100
9	Centerra Gold Inc./Barrick - Ren	0	100	100
16	Newmont - Mike	0	100	100

Table 3.1-1 Mining-related Surface Disturbance Associated with Past and Present Actions and RFFAs

Map Reference No.	Action	Past and Present Disturbance (acres)	RFFA Projected Disturbance (acres)	Total Approved/ Projected Disturbance (acres)
--	Sand and Gravel Operations	395	--	395
Exploration				
1	Great Basin Gold - Ivanhoe	15	--	15
2	Hecla - Hollister Development Block	51	--	51
4	Trio Gold Corp - Rodeo Creek	42	--	42
5	Barrick - Meridian JV - Rossi	51	--	51
9	Centerra - Ren	30	--	30
11	Barrick - Goldstrike Project	233	--	233
12	Newmont - Carlin	255	--	255
14	Newmont - Chevas	168	--	168
15	Newmont - High Desert	164	--	164
16	Newmont - Mike	48	--	48
18	Newmont - Woodruff Creek	66	--	66
20	Newmont - Emigrant Springs	63	--	63
21	Royal Standard Minerals - Railroad - Piñon	20[1]	200[1]	220[1]
Total		33,265	3,920	37,185

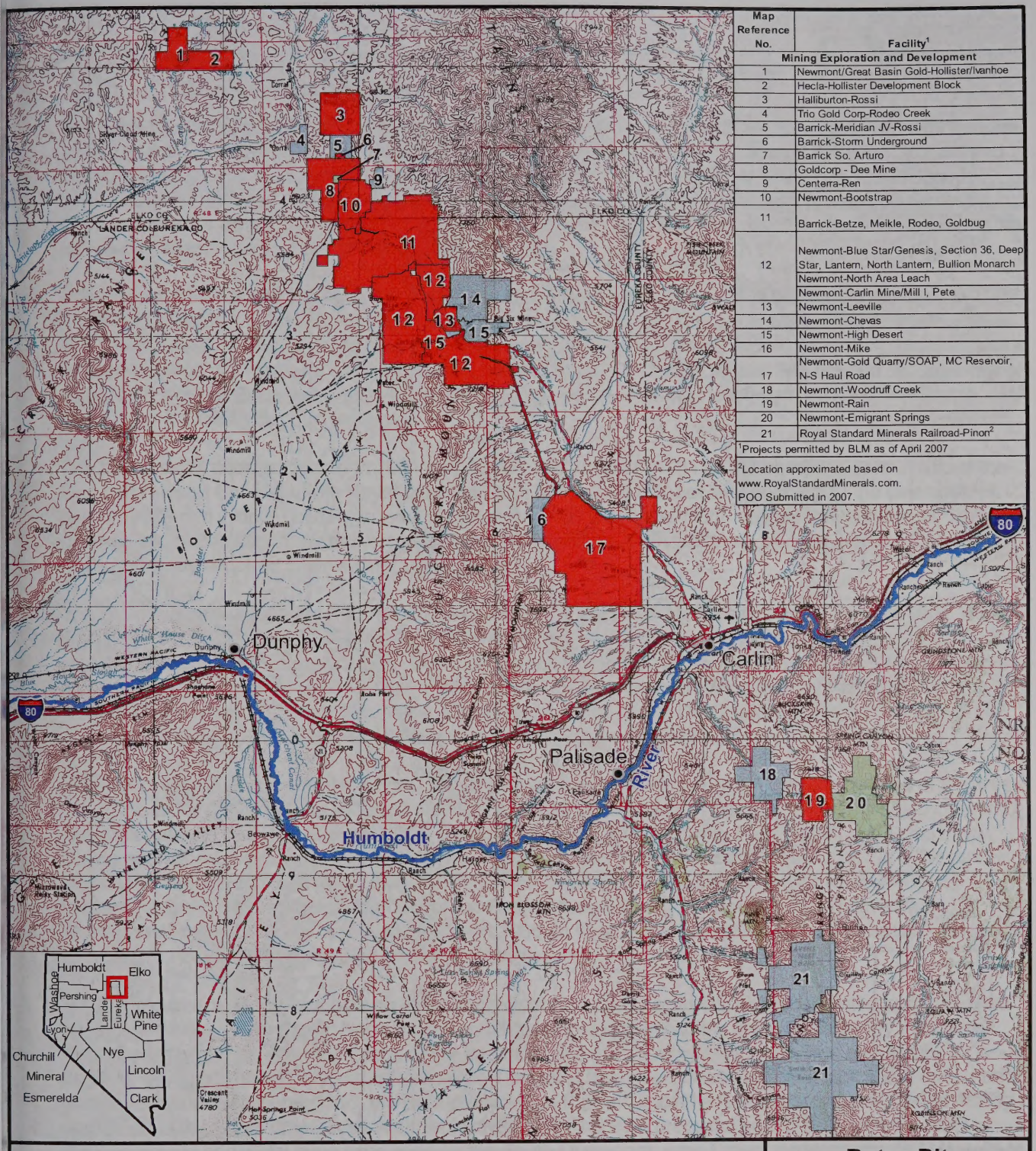
[1]Approximate acreage.

Source: BLM 2007a,b.; BGMI 2007a.

The geographic area for potential cumulative effects is determined by the type of resource potentially affected. **Figures 3.1-1** and **3.1-2** show the distribution of the primary surface-disturbing actions throughout the Cumulative Effects Study Areas (CESAs). Information on these actions is presented below. The area of concern for cumulative effects varies by resource, with impacts for certain resources being restricted to the actual area of disturbance. Resource-specific CESAs and rationale were developed for each resource, as appropriate, and are discussed in Sections 3.2 through 3.14. The Carlin Trend is the CESA for several resources. The Carlin Trend is a mineralized zone approximately 50 miles long by 5 miles wide in north central Nevada where multiple mining operations have been developed.

3.1.1 Past and Present Actions

The past and present projects and actions considered in the cumulative effects analysis are described below. Their associated acreages are presented in **Table 3.1-1**. Included in this category are the historic and ongoing projects and actions found within the general vicinity of the proposed project.



Map Reference No.	Facility[1]
	Mining Exploration and Development
1	Newmont/Great Basin Gold-Hollister/Ivanhoe
2	Hecla-Hollister Development Block
3	Halliburton-Rossi
4	Trio Gold Corp-Rodeo Creek
5	Barrick-Meridian JV-Rossi
6	Barrick-Storm Underground
7	Barrick So. Arturo
8	Goldcorp - Dee Mine
9	Centerra-Ren
10	Newmont-Bootstrap
11	Barrick-Betze, Meikle, Rodeo, Goldbug
12	Newmont-Blue Star/Genesis, Section 36, Deep Star, Lantern, North Lantern, Bullion Monarch
	Newmont-North Area Leach
	Newmont-Carlin Mine/Mill I, Pete
13	Newmont-Leeville
14	Newmont-Chevas
15	Newmont-High Desert
16	Newmont-Mike
17	Newmont-Gold Quarry/SOAP, MC Reservoir, N-S Haul Road
18	Newmont-Woodruff Creek
19	Newmont-Rain
20	Newmont-Emigrant Springs
21	Royal Standard Minerals Railroad-Pinon[2]

[1]Projects permitted by BLM as of April 2007

[2]Location approximated based on www.RoyalStandardMinerals.com. POO Submitted in 2007.

LEGEND

- Area of Current Major Exploration
- Areas of Existing and Reasonably Foreseeable Development as Defined by Mine Plan Boundary
- Locations of Reasonably Foreseeable Mine Developments

N

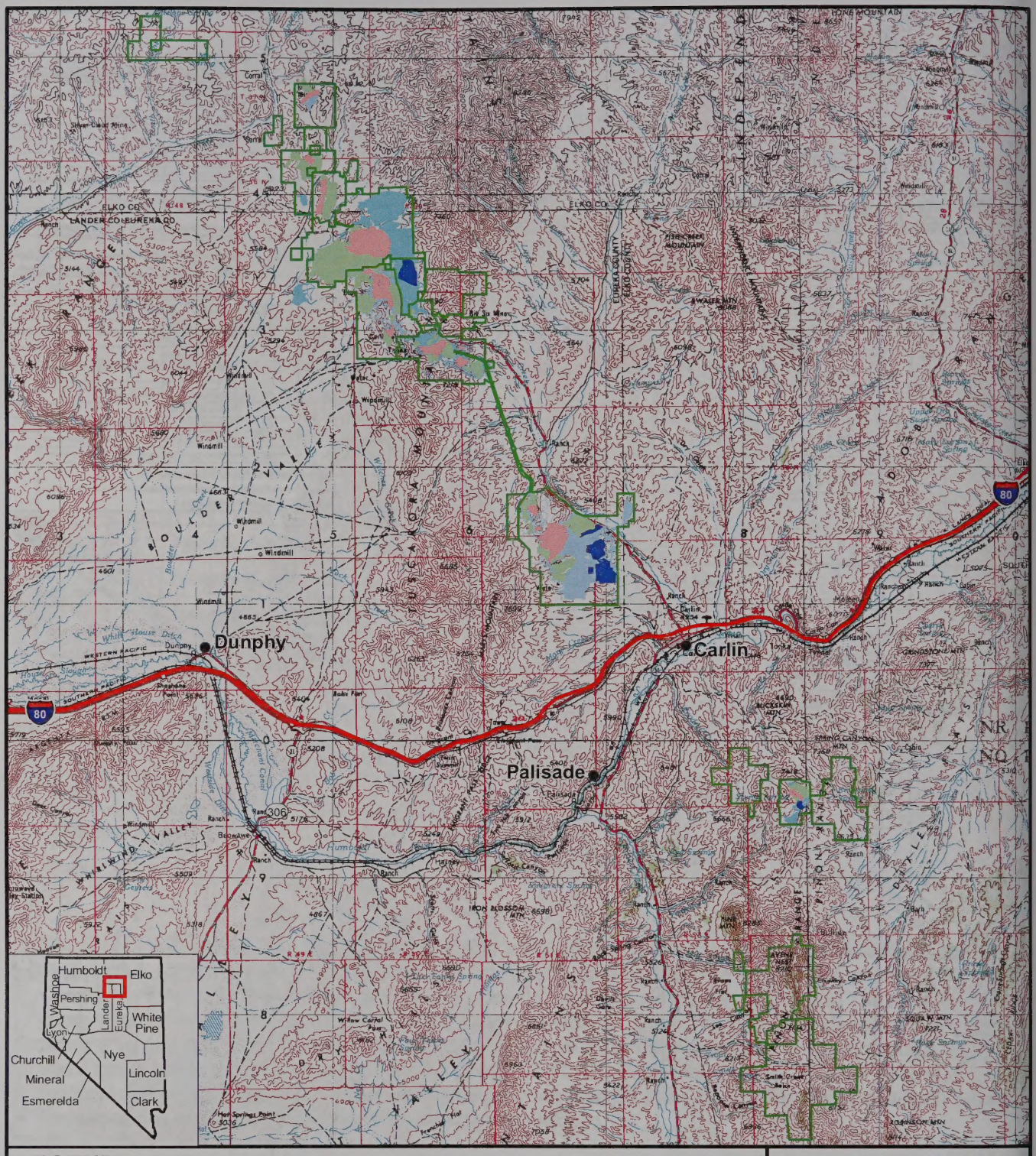
0 2.5 5 Miles

Source: BLM 2007b,c.

Betze Pit Expansion Project

Figure 3.1-1

Past, Present, and Reasonably Foreseeable Future Mining Activities - Carlin Trend in Nevada



LEGEND

- Ancillary
- Leach Pad
- Pits
- Waste Rock Dumps
- Mine Plan Boundaries

N

0 2.5 5 Miles

Source: BLM 2007b,c.

Betze Pit Expansion Project

Figure 3.1-2

Mine Disturbance - Carlin Trend in Nevada

3.1.1.1 Mining-related Disturbance

Gold was first discovered in 1907 in Lynn Creek, 19 miles northwest of Carlin, within what would later become known as the Carlin Trend (Tingley 1998). Placer gold deposits also were discovered in Sheep, Rodeo, and Simon creeks around the same time period. Prior to the 1907 gold discovery, claims in the Carlin Trend produced silver and lead. More modern and larger scale mining activities began with Newmont's Carlin Pit in 1965 and BGMI's Betze/Post Mine in 1986. Brief descriptions of the past and present mines considered in the cumulative effects analysis are presented below.

Polar Resources initiated mining in the area of the Betze/Post Mine in 1974. BGMI acquired the mine in 1986, expanded operations, and has continued mining to the present at what is now known as the Goldstrike Mine. The Goldstrike Mine includes the Betze Pit, Meikle and Rodeo underground mines, processing facilities, waste rock and tailings facilities, and ancillary support facilities, as described in Chapter 2.0. Current disturbances are associated with the Betze open-pit, waste rock facilities, roads, reclaimed leach pad, mill and processing facilities, and ancillary support facilities.

The Dee deposit was discovered in 1981 and put into production in 1984 by the operating partnership of the Dee Gold Mining Company with Rayrock Mines Inc. Glamis Gold Ltd. became operator of the Dee open-pit mine in 1999 and initiated underground production from the Dee Deep North deposit that same year. Both the open-pit and underground mines were shut down in December 2000. Goldcorp Inc. acquired the Dee Mine when it recently acquired Glamis Gold Ltd.

The Storm underground mine (Storm Decline) is located a few miles northwest of the Goldstrike Mine. BGMI developed the Storm Decline from the lowest level of the Dee open pit in March 1999. The Storm Decline Mine was developed to explore ore bodies and identify potential gold-bearing ore reserves on the Barrick-Meridian joint-venture. It is currently used to extract ore from that joint venture, which began commercial production in April 2007. The open pit barite Rossi Mine is located above the Storm Decline Mine. This open-pit mine is currently operated by Haliburton and has been producing barite since 1947.

Newmont Mining Corporation (Newmont) began its mining activities in the North Operations Area at the Blue Star Mine in 1974. The North Operations Area includes all of Newmont's mining operations located between the Bootstrap and Pete mines (North Star, Genesis, Bobcat, Lantern, Carlin, Beast, Sold, and Deep Star). Mining operations at the Bootstrap open-pit mine were initiated in 1974 and continued until 1984. Closure and reclamation were completed at the mine in 1988. Mining operations were reinitiated by Newmont at the Bootstrap Mine in 1994 with development of the Capstone and Tara gold deposits. Newmont's Blue Star/Genesis open-pit mines began operations in 1986. In 1988, Newmont constructed and began operations at the North Area Leach Facility and Mill #4 process facilities.

In 1979, Newmont discovered gold on their South Operations Area property. Open-pit mining began in 1980 and has expanded periodically. Newmont's South Operations Area consists of the Gold Quarry, Mac, and Tusc open-pits; a mine dewatering and water treatment and management system; waste rock disposal facilities; tailings disposal facilities; ore processing facilities; heap leach facilities; access and haul roads; and ancillary support facilities. In 1993, the BLM prepared an EIS and issued a ROD approving expanded mining operations in the South Operations Area Project (SOAP). The BLM prepared an EIS and issued a ROD in 2002 approving additional mine expansion for the South Operations Area Project Amendment (SOAPA). BLM released the draft cumulative effects SEIS for the SOAPA in August 2007 (BLM 2007c). Newmont's SOAP is located approximately 14 miles southeast of the Goldstrike Mine.

Dewatering and discharge activities in the Maggie Creek Basin result from Newmont's SOAP mining operation. The SOAP mitigation plan is currently in place to address potential adverse impacts from dewatering. Details of the dewatering and mitigation plan can be found in the SOAPA, August 2007, document (BLM 2007c). The Gold Quarry Mine currently discharges via Maggie Creek to the Humboldt River. This discharge was previously evaluated by BLM in the CIA of Dewatering and Water Management Operations for the Betze Project, SOAP, and Leeville Project (BLM 2000b).

Newmont's Leeville Project began mine development and operations in 2002 after the BLM issued an EIS and ROD in 2002. This underground gold mine is located approximately 3 miles southeast of the Goldstrike Mine project boundary. Major project components include the underground mine with one hoist and one ventilation shaft and underground access; the mine dewatering system, including a water treatment facility and pipeline system to convey groundwater from the Leeville Mine to BGMI's water management facility; a waste rock disposal facility; access and haul roads; shipment of ore to Newmont's Mill 6 facility in the South Operations Area; and ancillary support facilities. The BLM issued a draft cumulative effects SEIS on the Leeville Project in August 2007 (BLM 2007b).

Newmont acquired the Rain claims in 1979 and conducted exploratory drilling in the early 1980s to define the gold reserves. These deposits consisted mainly of Emigrant, Gnome, Snow Peak, Southern Mineralized Zone, Rain Extension, Tess, NW Tess, and Saddle. Mining operations were initiated at the Rain property in 1987. Mining operations consisted of open-pit and underground mining, waste rock disposal, ore processing, a tailings facility, heap leaching facility, and ancillary facilities. Open-pit mining at Rain continued through 1994. Underground operations began in 1994 and continued through 1998. Mining activity has ceased at the Rain Mine while heap leach processing and reclamation continues.

The Newmont/Great Basin Gold-Hollister/Ivanhoe mine occurs at the northwest end of the Carlin Trend. The property consists of an open-pit gold mine and exploration activities. The Hollister Development Block Exploration Project currently has dewatering and discharging activities of up to 350 gpm within Boulder Valley.

In addition to precious metal mines, sand and gravel mines also operate in the Carlin Trend. Approximately 395 acres of private land have been disturbed by sand and gravel operations in the Carlin area. These operations have been used to support construction maintenance of area roads (particularly Interstate 80 [I-80] and State Highway [SH] 766) (BLM 2007b,c).

3.1.1.2 Exploration-related Disturbance

Exploration activities include access road and drill pad construction and drilling. Exploration operations have resulted in isolated areas of land disturbance, as summarized in **Table 3.1-1**.

3.1.1.3 Utilities and Community Actions

Present utility and community actions resulting in surface disturbance in the CESAs include state, county, and public roads; the TS Power Plant; powerlines; and development primarily associated with the communities of Carlin, Elko, and Spring Creek. The TS Power Plant, transmission lines, and associated facilities are currently under construction 3 miles north of Dunphy in Eureka County, Nevada. The TS Power Plant is owned by Newmont's subsidiary Newmont Nevada Energy Investment, LLC. This 200-megawatt (MW) coal-fired power plant is expected to become operational in mid-2008 and provide power for Newmont's mining operations throughout northeast Nevada. Approximately 600 acres of surface disturbance is associated with the TS Power Plant (BLM 2007b,c).

Surface disturbance from roads has not been quantified for this analysis. Surface disturbance has occurred within the CESAs due to power line upgrades and ROWs establishment that support ongoing mining activities. Although there is a designated ROW associated with transmission lines and distribution lines, the associated surface disturbance typically is minimal (e.g., restricted to the pole locations and maintenance access, as needed).

Surface disturbance associated with residences, commercial development, and the supporting infrastructure exist in the towns of Carlin, Elko, and Spring Creek. Approximately 565 acres have been platted for development in the areas between I-80 and the Humboldt River in and adjoining the Town of Carlin. Other development is occurring east of SH 766 near its intersection with I-80. Another 23 acres have been platted at Palisades, midway between Carlin and Dunphy. Development in the Dunphy area consists of approximately 6 acres (BLM 2007b,c). Additional disturbances associated with these activities have not been quantified.

3.1.1.4 Other Development and Actions

Other development activities and actions considered in the cumulative effects analysis include fuel reduction programs and wildfires and wildlife management activities.

Wildfires

Between 1999 and 2007, approximately 38 percent (941,793 acres) of wildlife and livestock grazing habitat in the Wildlife and Vegetation Resources CESA has been impacted by fire. Since then, public and private entities have worked to restore 382,787 acres of range habitat for wildlife and livestock on areas affected by wildfire. Some tracts were allowed to revegetate naturally while critical habitat areas were being reseeded with forbs, grasses, and shrubs (BLM 2007b).

Wildlife Management Programs and Habitat Improvements

Several restoration projects for wildlife and riparian habitats have been implemented within the Carlin Trend area. Primary projects/programs include the following (BLM 2007b):

- BGMI Riparian/Wetland Conservation and Mitigation Fund - 1991 Betze Project
- Maggie Creek Watershed Restoration Project - Mitigation Plan for 1993 SOAP
- Mitigation Plan for 2002 SOAPA
- Mitigation Plan for 2002 Leeville Project
- BGMI Upper Willow Creek Habitat Enhancement Plan - Mitigation Plan for 2003 Betze Project
- Susie Creek Riparian Restoration Project
- Mule Deer Transition Range Seeding Project
- T Lazy S Sage-grouse Habitat Improvements
- 709-acre Mule Deer Habitat Improvement Project in the Sheep Creek Range
- NDOW Mule Deer Population Management Programs
- Trout Unlimited Strategies for Restoring Native Trout Program
- Beaver Creek Riparian Pasture

3.1.2 Reasonably Foreseeable Future Actions

In order to qualify as a RFFA for the cumulative effects analysis, a project or action must impact the same resources as the Proposed Action, must occur within the life of the Proposed Action (including reclamation), and must have a reasonable likelihood of going forward. The RFFAs identified in this cumulative effects analysis are discussed below; their associated disturbance acreages are presented in **Table 3.1-1**.

3.1.2.1 Mining-related Actions

Mining activities are expected to continue in the area in the foreseeable future. Reasonably foreseeable mine development in the area includes:

- Newmont/Great Basin Gold-Hollister/Ivanhoe: Foreseeable future actions include the operation of an underground gold mine and associated facilities at the same location as the Hollister Development Block Project.
- Halliburton-Rossi Mine: Planned activities include the expansion of Queen Lode and Sage Hen areas and possibly the expansion of surface exploration for open pits and waste rock dumps.

- Barrick-South Arturo: A 60/40 percent joint venture project with BGMI and Goldcorp Inc. A foreseeable future open pit gold mine at the former Dee gold mine.
- Newmont
  - North Area Leach Facility - RFFAs include the expansion of the existing heap leach pad.
  - North Lantern #3 - RFFAs include an open pit gold mine and the expansion of the Lantern Mine at the Blue Star-Genesis Plan Area.
  - Genesis Project - RFFAs include the continued mining of the Genesis Area, which includes open-pit mining, sequential backfill and increased height of existing external waste rock facilities.
  - Mike - RFFAs include the operation of a gold mine.
  - South Waste Rock Disposal Facility - RFFAs include the expansion of a leach pad and the construction of Property Pad.
  - Emigrant Project - RFFAs include the development of a new open-pit mine consisting of a waste rock disposal facility, heap leach, stream channel diversion, and construction of ancillary mine facilities. The proposed mine is located along the eastern slopes of the Piñon Range in the Dixie Creek Basin.

3.1.2.2 Exploration-related Actions

Mineral exploration activity would be expected to continue in the project region. Exploration drilling, trenching, and road construction at current and proposed mine operations would be expected to continue.

3.1.2.3 Community Actions

Community development activities will increase or decrease depending upon the strength of the local economy, employment levels and population. Development, both commercial and residential, is expected to continue at current levels in Carlin, Elko, and Spring Creek.

3.1.2.4 Other Development and Actions

Wildfires

Wildfires are likely to continue in the future in the project area. Prescribed burns will continue to be used to help reduce fuel loads in selected areas on public lands.

Wildlife Management Programs and Habitat Improvements

Habitat restoration activities in the area include reseeding areas disturbed by mining activities, fire, or livestock; limiting livestock access to riparian areas through strategic fencing and grazing management practices; and general restoration of seeps and springs. These activities are undertaken by both private and public entities and are expected to continue and even increase within the project area in the future. Habitat restoration measures are anticipated to improve habitat for terrestrial and aquatic species, including threatened and endangered species and species of concern. Sage-grouse habitat restoration will continue in the project region through programs implemented by NDOW and other organizations.

3.2 Geology and Minerals

3.2.1 Affected Environment

The study area for the direct and indirect impacts to geology and minerals encompasses the Goldstrike Mine operations boundary (**Figure 3.2-1**). The CESA encompasses the mine operations boundary and includes surface disturbance associated with past and present actions and RFFAs within the Carlin Trend (**Figure 3.2-2**). The Carlin Trend is an appropriate CESA boundary for geology and minerals since it incorporates an approximately 50-mile-long by 5-mile-wide district area of multiple major mineral deposits with similar emplacement and origin.

The geologic setting in the vicinity of the Goldstrike Mine has been discussed in detail in previous NEPA documents for the Betze Project (BLM 1991a,b, 1993, 2000a, 2003b). The discussion below provides a summary of regional and study area geology. Potential acid rock drainage formation issues are discussed in Sections 3.3, Groundwater Resources and Geochemistry and 3.4, Surface Water Resources.

3.2.1.1 Physiography and Topography

Major mountain ranges within the study area include the Sheep Creek Range and portions of the Tuscarora Mountains, Independence Range, and Adobe Range. The elevation ranges from approximately 8,700 feet amsl in the Tuscarora Mountains near the central portion of the study area to approximately 4,500 feet amsl along the Humboldt River in the southwestern corner of the study area.

The study area is located within the Basin and Range physiographic province and is characterized by a series of generally north-trending mountain ranges separated by broad basins. The Basin and Range physiography has developed from normal faulting that began approximately 17 million years ago and continues to the present (Stewart 1980). The extensional block faulting uplifted the mountains, which consist of Precambrian to Tertiary age bedrock units. The basins are filled with thick accumulations of unconsolidated and consolidated sediments that are derived from erosion of the adjacent mountain ranges.

3.2.1.2 Geological Setting

The geology of the area is shown in **Figure 3.2-1**. During the Late Devonian or Early Mississippian time, marine deposition was interrupted, and the Paleozoic sediments were uplifted, folded, and thrusted by the Antler Orogeny (orogeny is a geologic term for mountain building event). During the Antler Orogeny, the siliciclastic rocks were thrust over the carbonate rocks along the Roberts Mountain Thrust (Roberts 1966; Stewart 1980), a major structural feature within the region. The clastic rocks form the upper plate while the carbonate rocks form the lower plate of the thrust. The marine carbonate rocks underlie the siliciclastic assemblage throughout the study area. Stewart (1980) notes the clastic rocks in the upper plate have been displaced to the east by as much as 90 miles and are composed of interleaved broad, thin thrust sheets that are oriented sub-parallel to the bedding.

The Antler Orogeny also created a highland that persisted during much of the Mississippian period and perhaps during parts of the Pennsylvanian and Permian periods (Stewart 1980). During the Late Paleozoic Era, sediments shed from the highland resulted in deposition of clastic and carbonate rocks (Antler Sequence). These rocks are grouped by Maurer et al. (1996) with the Paleozoic marine carbonate rocks, although the rocks are primarily siliciclastic.

During the Mesozoic and Early Cenozoic eras, the area was subjected to compression, which resulted in the Tuscarora Mountain anticline and may have fractured the rocks in the vicinity of the anticline, providing pathways for mineral-bearing fluids and groundwater. Intrusive igneous activity accompanied this compression. The Marys Mountain intrusive complex, long postulated on the basis of geophysics and recrystallization, is composed of rocks that span from Jurassic through Tertiary (Evans 1974).

Beginning in the late Cenozoic Era, the area was block-faulted by a series of normal and listric faults that created the Basin and Range topography that characterize the region. Broad valleys in the regional study area, such as Boulder Valley and the Maggie Creek basin, were formed as down-dropped blocks between uplifted mountain ranges. Major normal faults bound the southeastern flank of the Sheep Creek Range, the eastern flank of the Tuscarora Mountains, and the northern side of the Argenta Rim (Maurer et al. 1996). These normal faults drop the basin side down relative to the mountain side, may have displacements of thousands of feet, and are usually at high angles.

The Tertiary Carlin Formation consists of tuffaceous fluvial and lacustrine sediments. Uplift and subsequent erosion of the mountains during the late Cenozoic Era have partially filled the basins with poorly consolidated to unconsolidated silty clay, silt, clayey sand, sand, gravel, and boulders deposited primarily as a series of coalescing alluvial fans. These basin-fill deposits are mapped as two types: 1) older basin-fill deposits, and 2) younger basin-fill deposits (Maurer et al. 1996). The older basin-fill deposits are Miocene to Pliocene in age and consist of fluvial and lacustrine sediments, volcaniclastic rocks, and volcanic rocks. In Boulder Flat, the older basin-fill deposits may be as thick as 3,000 feet, while in the Maggie Creek basin the older basin-fill deposits may be in excess of 5,000 feet (BLM 2000a, 2003a). The younger basin-fill deposits (alluvium) consist of unconsolidated alluvium deposits that underlie present-day streams, flood plains, and associated stream terraces. These deposits are highly variable and consist of silty clay, sandy clay, silty sand, clayey sand, gravel sand, and conglomerate (BLM 2000b). The thickness ranges from a few tens of feet in the mountains to 1,000 feet in the southern part of Boulder Flat.

3.2.1.3 Site Geology

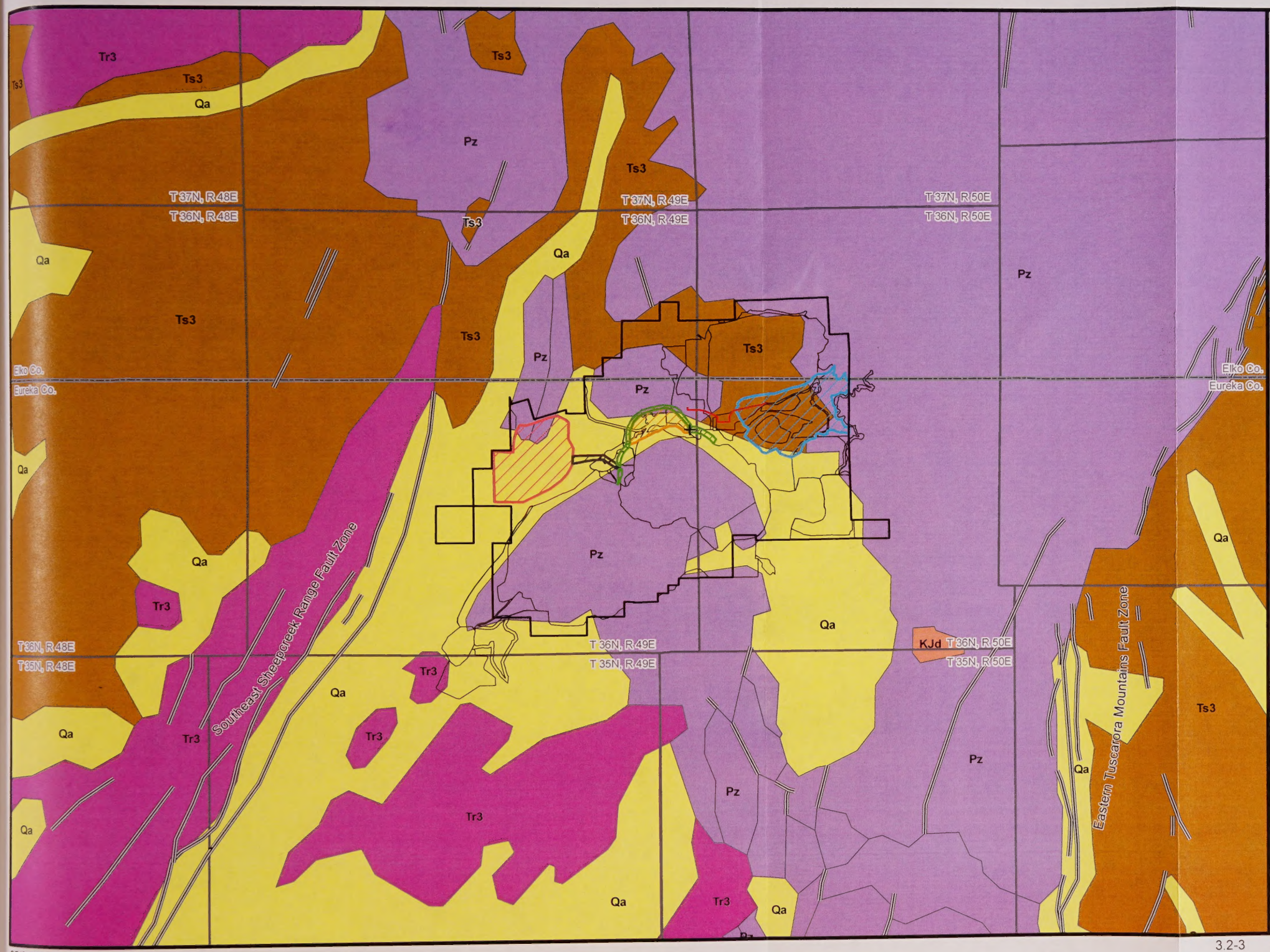
The project site is located at the northern end of Boulder Valley, on the west side of the Tuscarora Mountains (BLM 1991a,b). The area is cut by numerous north-trending faults that have resulted from several episodes of deformation and igneous intrusion. The geologic setting is composed of Lower Paleozoic marine sedimentary rocks, a Jurassic intrusive, Late Tertiary tufaceous deposits (Carlin Formation), and Quaternary fluvial and colluvial sediments.

The granodioritic Jurassic Goldstrike Stock intrudes the Lower Paleozoic Age sedimentary formations in the project area (BLM 1991a,b). Contact metamorphism, as a result of the intrusion, has developed minor skarn (lime-bearing silicates) along the contacts of the intrusive with the calcareous sedimentary rock. Numerous dikes and sills have intruded the sediments along structural zones.

The host rocks of the Betze orebody are Ordovician through Devonian rocks of the Vinnini Formation, and Devonian and Silurian and consist of the lower Rodeo Creek unit, Popovich limestone, and upper Roberts Mountains Formation (Peters et al. 1998). These units are composed of limestone, dolomite and siliciclastic material and also contain sedimentary breccias. These rocks host the Betze orebody and other orebodies along much of the north-central Carlin Trend. The rocks in the area have been altered and deformed by the intrusion of the hydrothermal solutions that emplaced the ore body. The Betze ore body is associated with north-northwest striking faults (Peters et al. 1998). The ore in the Betze orebody is highly sheared and fractured, and the host rocks are highly thermally altered.

3.2.1.4 Mineralization and Mineral Resources

The major mineral resource in the project area is precious metal gold deposits. The mine is located in the Carlin Trend, an approximately 50-mile-long assemblage of gold deposits in northeast Nevada (Teal and Jackson 2002). The trend is aligned northwest to southeast and contains gold deposits that are largely hosted in carbonate rocks. The Carlin trend contains a number of active mines that were responsible for 50 percent of Nevada's gold production in 2005 and had cumulatively produced over 60 million ounces of gold (Price et al. 2006). Ultimate production could top 100 million ounces from the trend. The Goldstrike property (Betze-Post open pit and the Meikle and Rodeo underground mines) had cumulatively produced over 30 million ounces of gold as of mid-2006 (Barrick Gold Corporation 2007). In 2006, the property produced 1.9 million ounces of gold. Proven and probable reserves at the Betze-Post pit were about 13 million ounces of gold as of December 31, 2006.



LEGEND

- Goldstrike Mine Operations Boundary
- Tailings
- Pit Expansion
- Perimeter Buffer to Laybacks
- Waste Rock Facility
- Clydesdale Haul Road
- Tailings Pipeline
- Existing Facilities
- Rodeo Mine
- Faults

Units

- Qa (Alluvium)
- Tr3 (Tertiary Igneous)
- Ts3 (Carlin Formation)
- KJd (Cretaceous-Jurassic Diorite)
- Pz (Paleozoic Rock)

Source: Stewart and Carlson 1978; Sawatsky and Connors 1996.

N W E S

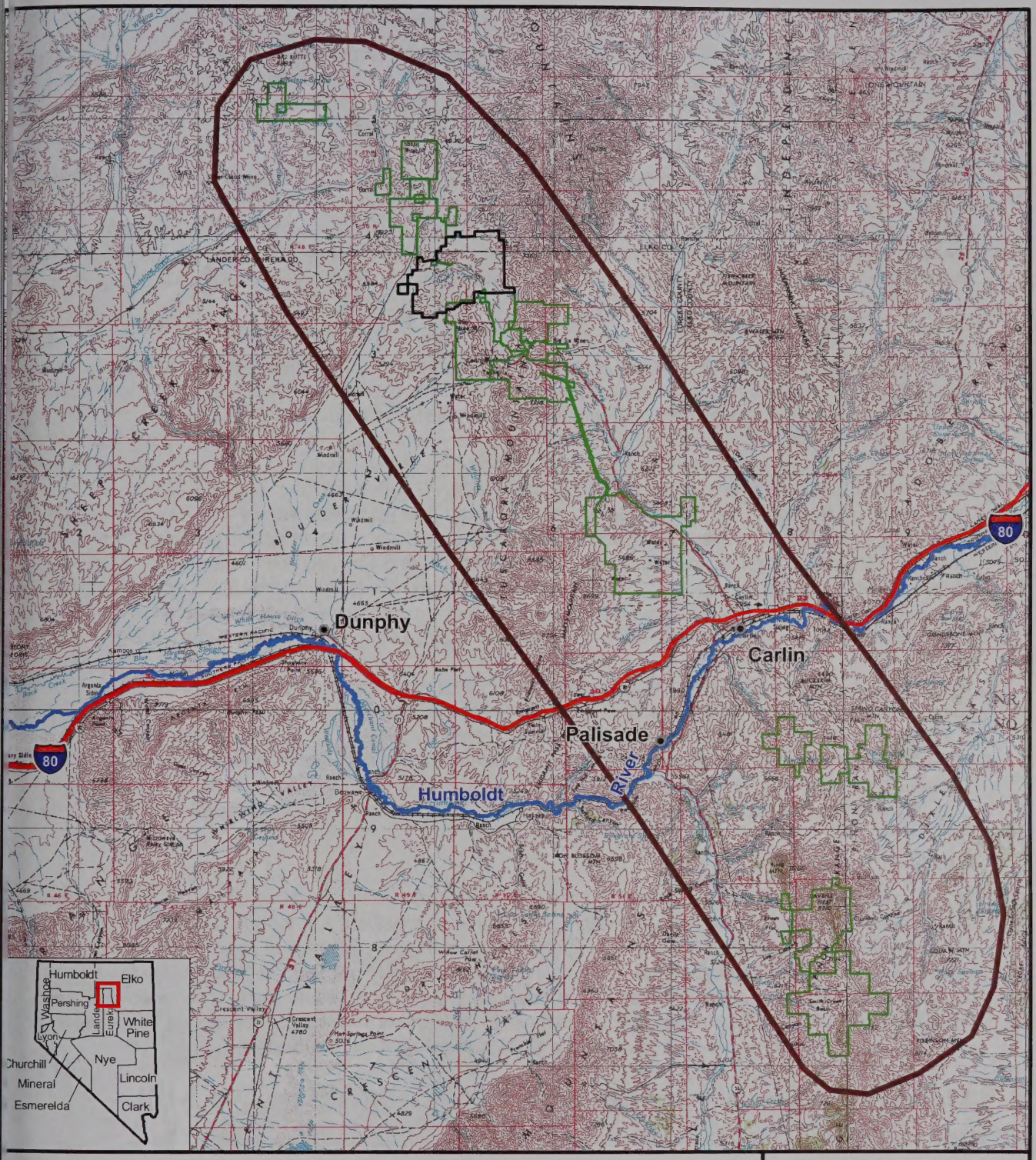
0 1 2 Miles

Betze Pit Expansion Project

Figure 3.2-1

Geology of the Area

05/20/2008



LEGEND

- Geology Cumulative Effects Study Area
- Goldstrike Mine Operations Boundary
- Mine Plan Boundaries

N

0 2.5 5 10 Miles

Source: BLM 2007b,c.

Betze Pit Expansion Project

Figure 3.2-2

Geologic Resources Cumulative Effects Study Area

06/13/2008

The gold deposits within the Carlin Trend largely resulted from the emplacement of igneous intrusions during Eocene time (39 million years ago), but also other minor gold episodes occurred in late Jurassic and Devonian times (Bettles 2002). The gold deposits are primarily in Paleozoic carbonate rocks and the gold occurs as very minute particles in the lattices of pyrite and arsenopyrite (Teal and Jackson 2002).

The other major mineral resource in the area is barite. The Rossi Mine, a few miles northwest of the Betze mine is owned by Halliburton (Baroid Drilling Fluids), which shipped about 169,000 tons in 2005 (Castor 2006). Geothermal resources occur within the Carlin Trend. Two tracts of land have been issued leases for geothermal resources (BLM 2007b). The potential for oil and gas reserves within the Carlin Trend is relatively low; most of the leases in the vicinity occur to the northeast of Carlin (BLM 2007b,c).

3.2.1.5 Faulting and Seismicity

The study area is located in a region that is characterized by active and potentially active faults and a relatively high level of historic seismicity. For the purposes of this evaluation, an active fault is one that shows evidence of displacement during the Holocene period (last 10,000 years), and a potentially active fault is one that shows evidence of surface displacement during the late Quaternary period (last 1.6 million years) (Hart and Bryant 1999). Historically, surface displacement along faults occurred in Nevada during major earthquakes in 1869, 1903, 1915, 1932, and three events in 1954 (Stewart 1980). All of these events occurred along a north-trending zone called the Nevada Seismic Belt, located over 40 miles southwest of the study area. A review of the USGS fold and fault database indicated that potentially active faults are present in the study area, and active faults or historic faulting has occurred (Adams and Sawyer 1999; Adams et al. 1999; Anderson 2000; Oswald and Sawyer 1998). As shown in **Figure 3.2-1**, Quaternary faults occur along the southeastern edge of the Sheep Creek Range, and the southwestern flank of the Tuscarora Mountains. Major faults and hydrostructural features in the vicinity of the Goldstrike Mine are shown in **Figure 3.2-3**.

The closest known historic surface fault displacement to the regional study area was in 1915, approximately 60 miles to the southwest (Von Hake 1974). The study area is located in a region that has experienced moderate seismic activity in historic time. Earthquake records from 1977 to present indicate that 15 earthquakes have been recorded within an approximate 60-mile radius of the study area (USGS 2007). These earthquakes registered magnitudes of 3.0 to 4.6. The proposed project is in an area that is not likely to experience strong ground motions in the event of a large magnitude earthquake (Frankel et al. 1997).

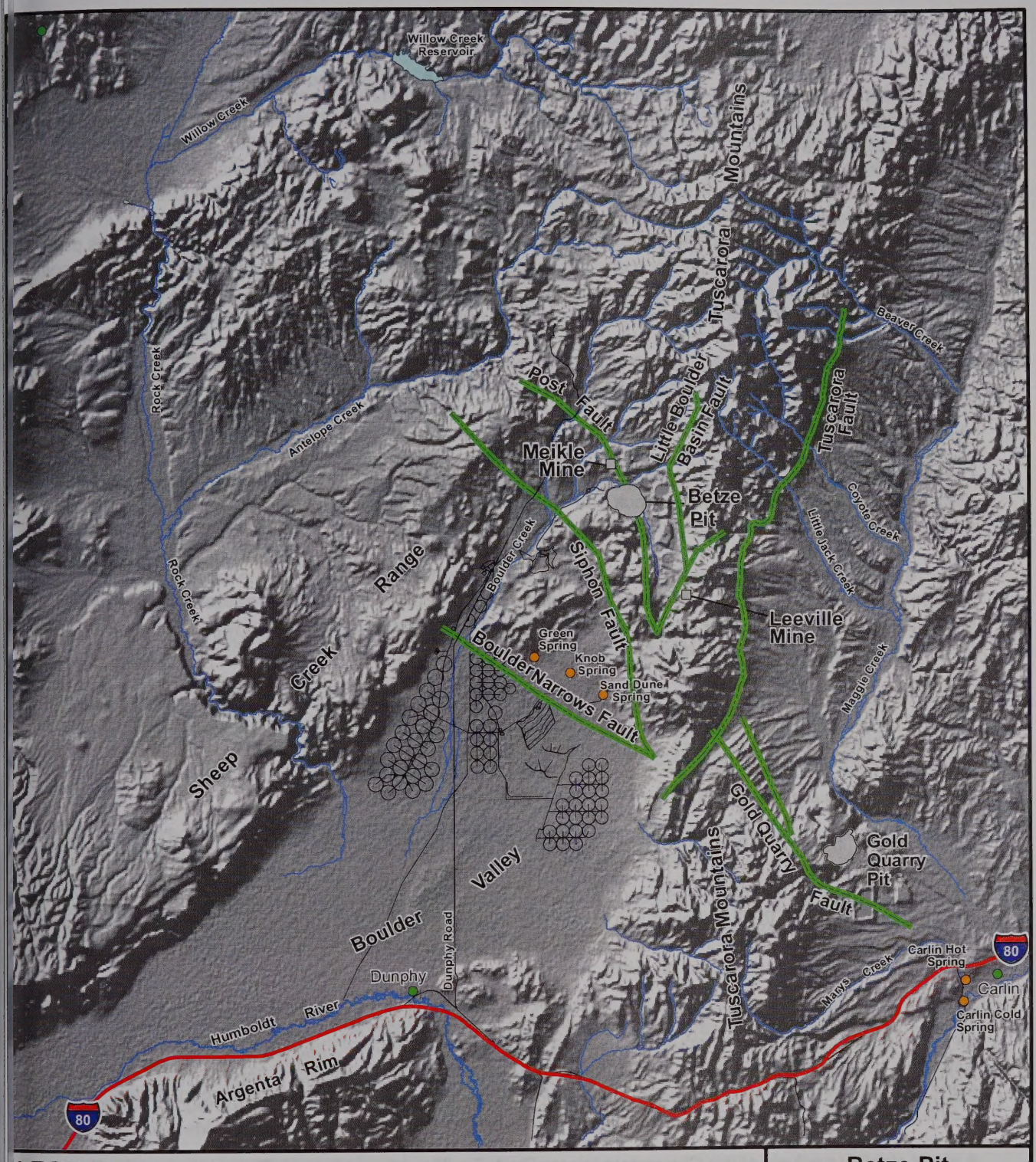
3.2.1.6 Subsidence

As documented in BLM's CIA (2000b), there are areas that may be susceptible to ground subsidence and sinkhole development resulting from de-watering. The ground subsidence probably occurs when drawdown of the water table from dewatering causes piping and collapse of unconsolidated deposits into to pre-existing voids or fractures in carbonate bedrock. Three sinkholes developed from 1993 to 1998, but no sinkholes have been reported since then. It is probable that the drawdown has progressed through thin layers of alluvium and that if there are voids present in the carbonates rocks in the zone of influence of dewatering, the alluvium or overlying strata are sufficiently thick to attenuate surface manifestation of subsidence.

3.2.2 Environmental Consequences

Major issues related to geology and minerals include:

- Extent of mineral extraction and amount of materials associated with precious metals development;
- Geologic hazards created or exacerbated by development of the proposed project;
- Surface subsidence resulting from the lowering of the groundwater table; and
- Exclusion of future mineral resource availability caused by the placement of facilities.



LEGEND

- Streams
- Faults (Includes Inferred Faults)
- Springs
- Center Pivots
- Towns

N

0 2 4 8 Miles

Source: BLM 2000a.

Betze Pit Expansion Project

Figure 3.2-3

Major Hydrostructural Features

05/20/2008

3.2.2.1 No Action Alternative

Under the No Action Alternative, the proposed Betze Pit Expansion Project would not be developed, and the potential impacts due to mineral extraction to geologic and mineral resources would not occur. However, a mineable reserve would be left in the ground and may not be available in years hence because the mine infrastructure would not be available to extract and process the ore. Under this alternative, dewatering operations to maintain the current water table below the Meikle Mine will continue through 2015 under existing permits and authorizations from the State of Nevada. No dewatering-induced surface subsidence impacts are anticipated due to dewatering operations. As described in Section 3.2.1.6, sinkhole development has probably reached equilibrium given the absence of sinkhole development in the last 10 years. Based on the foregoing, there is low potential for recurrence in sinkhole prone areas, with dewatering operations continuing through 2015. The existing mining and ore processing activities associated with current operations would continue under existing authorizations. Potential impacts to geologic and mineral resources previously were analyzed in the Mill and Tailings Pond EA (BLM 1988); Betze Project EIS (BLM 1991a,b); Meikel Mine EA (BLM 1993); and Betze Project SEIS (BLM 2000a, 2003a).

3.2.2.2 Proposed Action

Direct impacts of the Proposed Action on geologic and mineral resources would include the generation and disposal of 315 million tons of waste rock and 12.44 million tons of tailings; the removal of 0.5 million tons of Carlin Formation material suitable for reclamation use; and the extraction of 12.44 million tons of ore.

The Proposed Action would result in an extension of the permanent alteration of the landscape and disturbance of approximately 1,180 acres. This disturbance includes unreclaimed areas disturbed by the open pit (Betze Pit), reclaimed waste rock disposal areas, and tailings impoundment that would permanently alter the natural topographic and geomorphic features in the area.

There are several potentially active faults in the proposed project vicinity that could cause ground motion in the event of an earthquake. USGS ground motion hazard maps indicate that there is a low probability that ground motion presents a hazard at the site. There are no identified geologic conditions that would be exacerbated by project activities that would result in geologic hazards. Pit wall, waste rock dump, and the tailings facility would be constructed to conform to regulatory standards to minimize instability.

The pit slopes, tailings facility, and waste rock facilities have been designed to provide for long term stability and safety (BGMI and SRK 2007). The design of the open pit has taken in to account BGMI's knowledge of the rock materials, geotechnical tests, and MSHA design standards. As mining occurs, design parameters and assumptions would be tested against actual conditions. Monitoring of the conditions would be accomplished through geological and geotechnical evaluation involving geologic structure mapping, groundwater monitoring, and slope stability monitoring and analysis.

The Goldstrike No. 3 Tailings Facility would consist of a dam and geosynthetic lined impoundment behind the dam. An internal drain system would be installed in the upstream face of the dam to prevent the buildup of fluid within the embankment. The liner under the impoundment would be designed to exceed NDEP and BLM standards. An underdrain system under the liner would be used to capture flows from seeps and springs in the drainage. Flow would be collected and diverted down stream of the dam.

A slope stability analysis of the Clydesdale Waste Rock Facility was conducted. The waste rock facility would be terraced, where appropriate to accommodate recontouring and reclamation. Bench heights would be in lifts of approximately 100 feet and during reclamation, terraces would be incorporated into the slopes resulting in a stable slope configuration of 2.5-2.8H:1V.

The proposed waste rock and tailings facilities are not located in areas that have been susceptible to subsidence. The proposed project would not affect access to other mineral resources.

3.2.2.3 Bazza Waste Rock Facility Alternative

Under this alternative, waste rock from the proposed pit expansion would be disposed of in the existing Bazza Waste Rock Facility and in the Betze Pit as backfill; the Clydesdale Waste Rock Facility and haul road would not be constructed. Potential impacts under this alternative would be similar to the Proposed Action, with the following exceptions:

- The addition of the waste rock would not increase the total topographic footprint of the Bazza Waste Rock Facility;
- The Bazza facility capacity would be increased by 350 million tons to 2,280 million tons and have a maximum height of approximately 800 feet; and
- Under this alternative, 572 acres of disturbance associated with the proposed Clydesdale Waste Rock Facility and haul road would not occur.

The placement of waste rock would conform to the Bazza Waste Rock Management Plan (Schafer and Geosystems 2006) and slope stability requirements as approved by NDEP. As a result, significant slope instability of the Bazza Waste Rock Facility is not anticipated. Waste rock disposal would not preclude access to mineral resources since it is an existing facility.

3.2.3 Cumulative Impacts

3.2.3.1 No Action Alternative

The CESA for geology and minerals is shown in **Figure 3.2-2**. The past and present actions and RFFAs in this area are identified in Section 3.1, their locations are shown in **Figures 3.1-1** and **3.1-2** (see Section 3.1, Past, Present, and Reasonably Foreseeable Future Actions). Primary mineral production in these areas has included gold, silver, barite, and lead. Most of the mineral production has come from gold mining operations. Gravel has been mined for road construction. Surface mining activity affects geology and mineral resource by excavating, modifying, or covering natural topographic and geomorphic features and by removing mineral deposits.

Mining disturbance in the CESA has included exploration (drilling, trenching, sampling, and road construction), open-pit and underground mining, and construction of waste rock, heap leaching, ore milling and processing, and tailings disposal facilities. For the purposes of this evaluation, disturbed areas (or geologic disturbance) is defined to include mine components such as open pits, waste rock areas, leach pads, and tailings impoundments that permanently alter the natural topographic and geomorphic features in the area, even if reclaimed.

Based on available information, past and present and reasonably foreseeable future mining-related activities have resulted, or would result, in approximately 38,000 acres of disturbance within the CESA, of which approximately 6,500 acres would remain as unreclaimed open pits with some partially filled with water (BLM 2007b,c). Approximately 1,500 acres of disturbance likely would remain for access roads and maintenance facilities to support post-closure activities, resulting in approximately 30,000 acres that would be reclaimed to approved post-mine uses in the reasonably foreseeable future.

3.2.3.2 Proposed Action

The Proposed Action would incrementally increase the permanent alteration of topography in the CESA by approximately 1,180 acres, which represents only 0.2 percent of the cumulative effects area.

3.2.3.3 Bazza Waste Rock Facility Alternative

The cumulative effects to geology and mineral resources associated with the Bazza Waste Rock Facility Alternative would be similar except that 608 acres of additional disturbance and permanent alteration of topography would occur, approximately 572 fewer acres than under the Proposed Action.

3.2.4 Mitigation Measures and Monitoring

No additional mitigation measures or monitoring requirements for geology and mineral resources are proposed.

3.2.5 Residual Impacts

Residual impacts would occur to the topography of the project area due to permanent alteration of the landscape.

3.3 Groundwater Resources and Geochemistry

Baseline water quantity and quality in the vicinity of the Goldstrike Mine have been described in past reports including the Betze Project Draft EIS (BLM 1991a,b), the Betze Project SEIS (BLM 2000a, 2003a), and the CIA of Dewatering and Water Management Operations for the Betze Project, South Operations Area Project, and Leeville Project (BLM 2000b), SOAPA (BLM 2007c), and Leeville Project (BLM 2000b). This section summarizes pertinent data on water resources from these reports and presents current information related to water management and water levels in the project area. Current information is available on seeps and springs from AATA International, Inc. (AATA) (2007) and on surface and groundwater in Boulder Valley from BGMI (2007f).

3.3.1 Affected Environment

The Goldstrike Mine is located within the Humboldt River basin in north-central Nevada. The Humboldt River basin covers an area of approximately 17,000 square miles; upstream of the project facilities, the river drainage occupies approximately 7,500 square miles. The Humboldt River flows within the Great Basin of Nevada and terminates in the Humboldt Sink south of Lovelock, Nevada.

The project-related study area for direct and indirect impacts to water resources is Boulder Flat (Hydrographic Area 61). It is bounded on the east and north by the Tuscarora Mountains and on the west by the Sheep Creek Range. Boulder Flat is bounded on the south by the Humboldt River (**Figure 3.3-1**). The CESA for water resources occupies approximately 2,073 square miles and includes six designated groundwater basins. These six groundwater basins are shown in **Figure 3.3-1** and are listed in **Table 3.3-1**. All six groundwater basins drain southward to the Humboldt River. The CESA for water resources in this SEIS is identical to the CESA analyzed in the CIA (BLM 2000b) and Betze Project SEIS (BLM 2000a, 2003a). The CESA is bounded by the Tuscarora Mountains on the north, the Adobe Range and the Independence Mountains on the east, and the Humboldt River on the south. As shown in **Figure 3.3-1**, the western boundaries of the Willow Creek and Rock Creek groundwater basins form the western boundary of the hydrologic study area. Elevations range from 8,800 feet amsl in the Tuscarora Mountains to 4,500 feet amsl along the Humboldt River.

Table 3.3-1 Major Subregions Within the Hydrologic Study Area

Nevada Designated Groundwater Basin	Basin Number	Approximate Land Area (square miles)
Susie Creek	50	220
Maggie Creek	51	410
Marys Creek	52	60
Boulder Flat	61	560
Rock Creek Valley	62	450
Willow Creek Valley	63	420

Source: Nevada State Engineer's Office 1992; Maurer et al. 1996.

3.3.1.1 Hydrogeologic Setting

Hydrogeologic investigations have been undertaken by BGMI on an ongoing basis since 1990 to provide information on the existing groundwater conditions in the project area as mining advances and to estimate the potential impact of proposed changes in the mine plan where groundwater is involved. The details of these investigations can be found in BLM (2000a,b, 2003a). Studies have involved: 1) evaluation of the potential

effects of mine dewatering; 2) compilation of the effects of groundwater use along the Carlin Trend; 3) development and updating of a groundwater flow model for the project area; 4) evaluation of the effects of water use on the Humboldt River; 5) cumulative evaluation of the effects of dewatering at the Gold Quarry Mine and other mines in the project cumulative impact area; 6) studies of groundwater quality and chemistry; and 7) estimation of final pit lake chemistry for the Betze Pit after cessation of mining (Schafer 2003, 2007).

Groundwater flow, recharge, storage, and discharge are dependent on the geology of the water-bearing units. In consolidated bedrock geologic units, groundwater flow and storage are dependent on the secondary porosity developed by fractures, faults, solution cavities in carbonate units, folds, and bedding planes. In alluvial basin geologic units, groundwater flow and storage depend more on primary porosity determined by grain size distribution, cementation of the grains, and the interconnection of pores and available pore space. Because geology controls groundwater flow, the geologic units in the project area have been grouped into hydrostratigraphic and hydrostructural units. For a more complete discussion of the geology of the project area the reader is referred to Section 3.2, Geology and Minerals.

Hydrostratigraphic Units

The geology of the project area can be divided into six hydrostratigraphic units. These units are discussed below and their hydrologic properties are summarized in **Table 3.3-2**.

Table 3.3-2 Summary of Hydrostratigraphic Unit Hydraulic Properties

Hydrostratigraphic Unit	Yield (gpm)	Estimated Hydraulic Conductivity (feet/day)	Estimated Transmissivity (feet^2/day)	Estimated Specific Yield (no units)
Younger Basin Fill	Up to 3,600 in Boulder Valley[2]	1 to 100[2]	4,500[1] – 13,400[2]	0.15 – 0.25[2]
Older Basin Fill	<100 – 1,000[1]	0.05 – 5.0[2]	20 – 14,000[2]	0.01 – 0.10[2]
Intrusive Rocks	Generally <100[2]	0.01 – 1.0[2]	NA	NA
Volcanic Rocks	Up to 5,800 in Boulder Valley[2]	0.1 – 200[2]	300 – 100,000[2]	0.0007 – 0.07[2]
Marine Clastic Rocks	10 – 600[2,3]	0.01 – 0.5[2]	30 -800[2]	0.0001 – 0.004[2]
Marine Carbonate Rocks	500 – 5,000[2]	0.1 - 100[2]	13 – 300,000[2]	0.0002 – 0.03[2]

[1]Maurer et al. 1996.

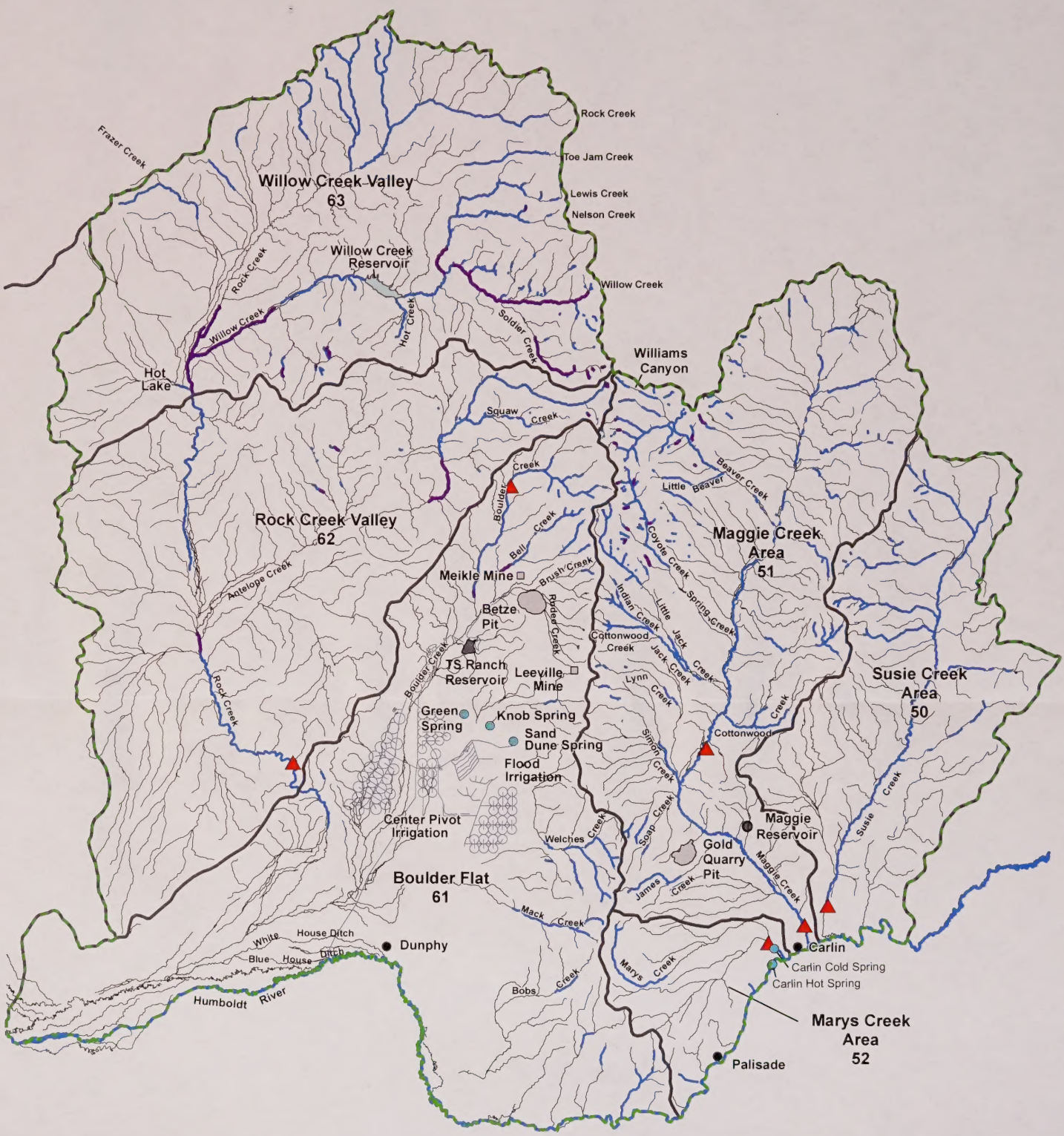
[2]McDonald Morrissey Associates, Inc. 1996a,b, 1998.

[3]Where highly fractured, may yield more than 600 gpm.

NA – No data available.

Paleozoic Marine Carbonate Rocks

These rocks consist of Paleozoic-age limestone and dolomite with lesser amounts of interbedded sandstone, shale, and quartzite. They are mainly Cambrian to Devonian in age but locally include carbonate rocks of Pennsylvanian and Permian age. These rocks are part of the Carbonate Rock Aquifer Province (Prudic et al. 1995) of eastern Nevada, a major bedrock carbonate aquifer that consists of marine platform carbonate rocks deposited in Paleozoic seas over millions of years. This Carbonate Rock Aquifer Province has its western-most boundary approximately 6 miles northwest of the Betze Pit. These carbonate rocks are exposed in the Tuscarora Mountains south of the Betze Pit and in bedrock outcrops in the Maggie Creek and Susie Creek basins.



3.3-3

Figure 3.3-1

Water Resources
Cumulative Effects
Study Area

Betze Pit Expansion Project

LEGEND

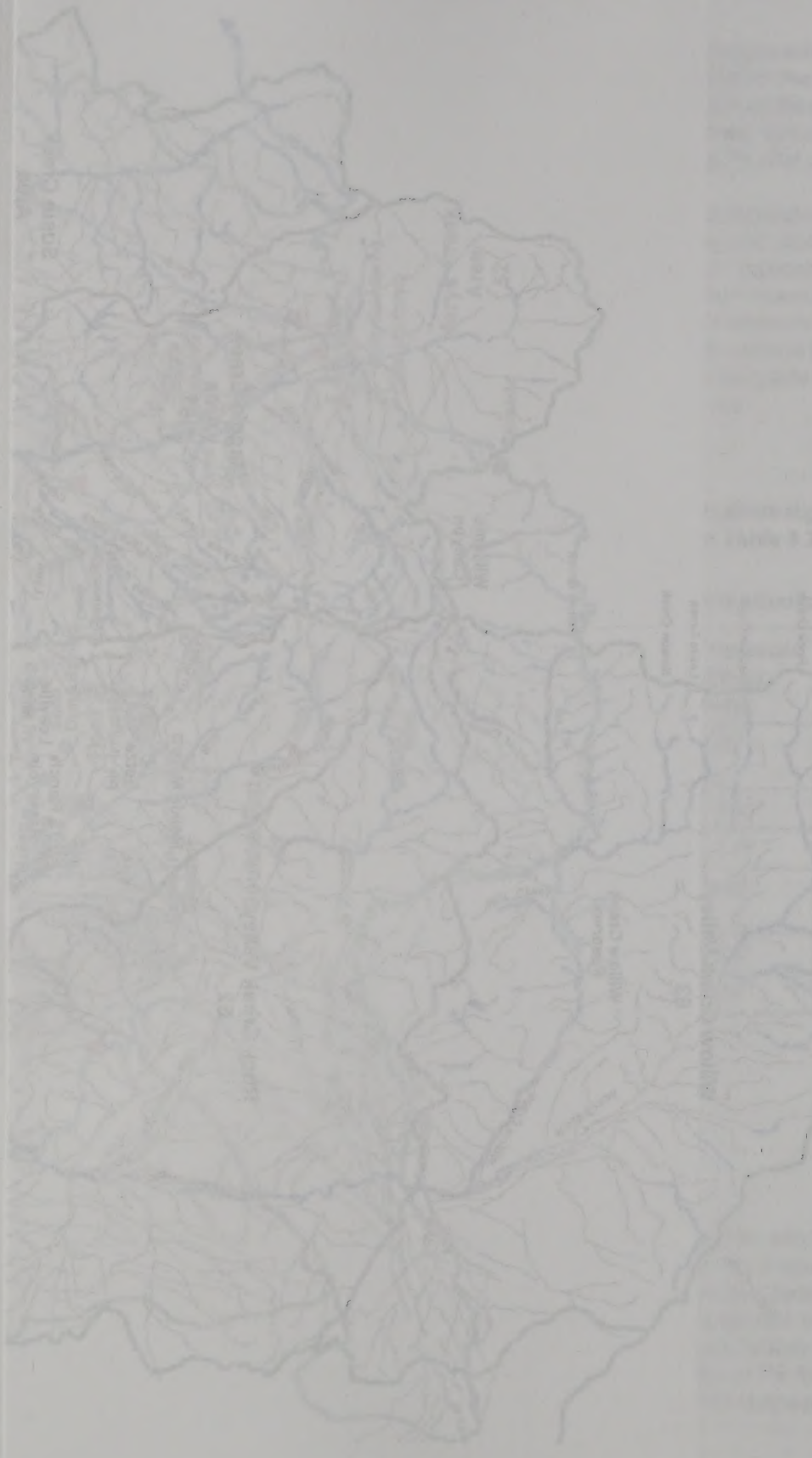
- Water Resources Cumulative Effects Study Area
- Groundwater Basin Boundary
- Stream (Intermittent or Ephemeral)
- Perennial Stream Reach
- Discontinous Flowing Stream Reach
- Location of Baseflow Predictions
- Center Pivot Irrigation
- Springs
- Towns

Note: Hydrographic Area boundary locations are approximate.
Source: BLM 2003a; USGS linegraph database.

N

0 5 10 Miles

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Marine carbonate rocks have a low primary, or matrix permeability. Secondary permeability developed by faults, fractures, bedding planes, and solution cavities can raise the bulk hydraulic conductivity of these rock units significantly. Secondary permeability can raise the hydraulic conductivity of the marine carbonate rocks to around 100 feet per day and result in a transmissivity as high as 300,000 feet squared per day. The specific yield for these rocks ranges from 0.0002 to 0.03. Yields from wells range from 500 to as much as 5,000 gpm due to secondary permeability.

Paleozoic Marine Clastic Rocks

These rocks consist of interbedded shale, siltstone, chert, quartzite, and some limestone. They consist of sediments that were deposited west of the Paleozoic platform carbonate rocks in subsiding basins. These stratigraphic units have been thrust eastward over the carbonate rocks by the Roberts Mountain Thrust throughout most of the project area and underlie the alluvial sediments and Tertiary volcanics. These clastic rocks are exposed in the Tuscarora Mountains, the Independence Range, and the Adobe Range. Their thickness ranges from 50 to 5,000 feet. The hydraulic conductivity is quite low, with reported values ranging from 0.01 to 0.50 feet per day. Transmissivity ranges from 30 to 800 feet squared per day and the specific yield ranges from 0.0001 to 0.004. Well yields are low and in the range of 10 to 600 gpm.

Jurassic-Tertiary Intrusive Rocks

These rocks are not abundant in the project area and range in composition from granodiorite to quartz monzonite and diorite, and form a relatively impermeable boundary immediately south of the Betze Pit. They also mark the southern extent of mineralization in the mine area. Hydraulic conductivities range from 0.01 to 1.0 feet per day, and well yields are generally less than 100 gpm.

Jurassic-Tertiary Volcanic Rocks

These rocks range from basalt flows to rhyolite ash-fall and ash-flow tuffs. The volcanic rocks are found throughout the project area and are commonly exposed in the western, northern, and southern parts of the hydrologic study area. The hydraulic properties of the volcanic rocks vary considerably due to the range in composition of the rocks and due to secondary permeability caused by faults and fractures, which enhance the hydraulic conductivity of the volcanics Estimates of hydraulic conductivity range from 0.01 to 200 feet per day, with transmissivity ranging from 300 to as much as 100,000 feet squared per day. The specific yield has been estimated to range from 0.0007 to 0.07. Yields to wells can be up to 5,800 gpm in the case of the Boulder Valley rhyolite.

Older Tertiary Basin-fill Deposits

These Pliocene to Miocene age deposits consist of poorly consolidated shale, claystone, mudstone, siltstone, sandstone, conglomerate, and fresh water limestone interbedded with volcanic tuffs and lavas. These deposits accumulated in basins during the early stages of extensional faulting and basin development. In the upper Maggie Creek basin, these deposits are up to 6,000 feet thick. In the Susie Creek and lower Maggie Creek basins, these sediments are approximately 2,000 feet thick. Well yields range from less than 100 to 1,000 gpm in these sediments. In the Maggie Creek area, hydraulic conductivity ranges from 0.05 to 5 feet per day with transmissivity values ranging from 20 to 14,000 feet squared per day. In the northern part of Boulder Flat, transmissivity ranges from 70 to 300 feet squared per day. The estimated specific yield is in the range of 0.01 to 0.10.

Quaternary Younger Basin-fill Deposits

These deposits range from sandy clay to gravelly sand and are unconsolidated. The thickness and lateral extent of these deposits are quite variable. In the basins, these sediments can be up to 1,000 feet thick. Along the mountain fronts, these sediments are considerably thinner and can be only tens of feet thick. The highly

variable composition of these sediments creates both confined and unconfined aquifers within the various sedimentary units, although for the most part this unit is an unconfined aquifer. Well yields can range up to 3,600 gpm in Boulder Valley, with hydraulic conductivities ranging from 1 to 100 feet per day, transmissivity ranging from 4,500 to 13,400 feet squared per day, and a specific yield estimated to range from 0.15 to 0.25.

Hydrostructural Units

Faults can serve as pathways for groundwater flow, or act as barriers to flow depending on the nature of the brecciation along the fault and the permeability of units juxtaposed by the faulting. Fractures, bedding planes, and cavities in bedrock units often allow for local flow of groundwater and create increased permeabitlity over a defined area. Long-term monitoring of water level changes in the vicinity of the Goldstrike Mine has resulted in the recognition of three major fault zones that impede groundwater flow across, that is perpendicular to, the strike of the fault zone. These three fault zones are discussed below.

Boulder Narrows Fault

The Boulder Narrows Fault is found in Boulder Valley (**Figure 3.2-3**) and has no surface expression. Evidence for this fault zone includes: 1) offset of rhyolite units in the area of the fault by approximately 700 feet; 2) the presence of the Green, Knob, and Sand Dune springs that were created by discharge of mine water to an infiltration reservoir; 3) gravity surveys by Newmont suggesting that Boulder Valley becomes 3,000 feet deep just south of the inferred fault trace; and 4) groundwater potentiometric surfaces in the valley alluvial sediments that are noticeably steeper and associated with higher water levels on the north side of the fault trace. The Boulder Narrows fault is thus inferred from this evidence and impedes groundwater flow southward across the fault.

Siphon Fault

This fault separates highly permeable marine carbonate rocks on the north from highly permeable volcanic rocks on the south. As shown in **Figure 3.2-3**, the fault acts as a barrier that separates the drawdown cone developed from mine dewatering north of the fault from the groundwater mound produced by infiltration of mine water south of the fault. Wells on either side of the fault record dramatically different water levels, with pre-mining water levels often differing by as much as 400 feet and currently differing by up to 1,200 feet.

Post Fault

This fault trends from southeast to northwest and is exposed in the east wall of the Betze Pit. Vertical movement along this fault has juxtaposed low permeability marine clastic rocks against higher permeability marine carbonate rocks. Prior to dewatering of the Betze Pit, exploration drilling indicated about a 100-foot drop in groundwater elevations from east to west across the fault. Dewatering has produced more dramatic water levels declines on the west side of the fault than on the east side, with up to a 1,600-foot difference across the fault zone.

Regional Faults

Other faults with the potential to influence groundwater flow and groundwater dewatering are the Little Boulder Basin Fault, the Tuscarora Fault on the east side of the Tuscarora Mountains, and the Gold Quarry Fault (**Figure 3.2-3**).

3.3.1.2 Geothermal System

A deep geothermal system exists in the Paleozoic carbonate rock aquifer. High-yield wells have reported temperatures at the well head of 140 to 145°F. This contrasts with wells drilled east of the Betze Pit in low permeability marine clastics that have well head temperatures of 70 to 90°F. This geothermal system, which

may be a remnant of Tertiary faulting and volcanism in this part of Nevada, may influence groundwater movement. To date, however, dewatering of the pit area has shown temperatures at the well head that have remained relatively constant.

3.3.1.3 Groundwater Levels

Groundwater levels are discussed by comparing pre-dewatering water levels with more current water levels that are the result of dewatering operations since 1991.

Pre-dewatering Groundwater Levels (Prior to 1991)

Prior to 1991, only limited data were available on groundwater levels in the project area. Unconfined groundwater levels for this period are shown in **Figure B-1** in **Appendix B**. These water levels are based on records from wells in the Boulder Flat area in 1990 and in the Maggie Creek area in 1988 (BLM 2000a). Water levels ranged from 5,700 feet amsl along the western flank of the Tuscarora Mountains to less than 4,600 feet amsl in the lower part of Boulder Valley. Along the eastern flank of the Tuscarora Mountains, water levels were recorded at 5,900 feet amsl and declined to 4,900 feet amsl near Carlin.

Current Groundwater Levels (2007)

Groundwater levels for the first quarter of 2007 (BGMI 2007f) are shown in **Figure 3.3-2**. This figure shows the change in groundwater levels and this groundwater flow patterns since dewatering began at the Goldstrike Mine in 1989. Groundwater levels around the Betze Pit are down to 3,575 feet amsl since September 2000 (Zhan 2007). Groundwater north of the Siphon Fault now flows mostly toward the Betze Pit, rather than down Boulder Flat toward the Humboldt River. In the Sheep Creek Range, groundwater levels are in the range of 4,800 feet amsl; in the Tuscarora Mountains, groundwater levels are around 6,800 feet amsl. The Siphon Fault affects groundwater levels and drawdown south of the Betze Pit. Groundwater levels in Boulder Flat in the area of the TS Ranch Reservoir and the irrigation fields are in the range of 4,600 to 4,800 feet amsl.

Figure 3.3-3 shows the changes in groundwater elevation in the Boulder Flat area since dewatering began in 1989. Drawdown in the area of the Betze Pit has been approximately 1,700 feet. In the area of groundwater reinjection in Boulder Flat, there is a groundwater mound in the Tertiary volcanics indicating an increase in water levels exceeding 30 feet and a groundwater mound in the Quaternary sediments indicating an increase in water levels of approximately 10 to 20 feet since 1990.

3.3.1.4 Groundwater Flow and Water Balance

Pre-dewatering Groundwater Flow and Water Balance

As shown in **Figure B-1**, groundwater flow based on data available prior to 1991, from a variety of monitoring wells in both bedrock and alluvium, was generally southward from the mountains toward the Humboldt River. In the Boulder Valley area, groundwater flow was from the divide along the crest of the Tuscarora Mountains westward into Boulder Valley and then southwest toward the Humboldt River. From the Sheep Creek Range along the west side of Boulder Valley, groundwater flow was southeastward into Boulder Valley and then toward the Humboldt River, and flow merged with that from the Tuscarora Mountains. In the vicinity of the Betze Pit, groundwater flow was southwestward and then south down Boulder Valley toward the Humboldt River. In Maggie Creek, groundwater flow followed a similar pattern with flow from the Tuscarora Mountains and the Independence Range converging in Maggie Creek, and then flowing toward the Humboldt near Carlin. West of the Sheep Creek Range, in Antelope Creek and Willow Creek, groundwater flow was generally southwestward from the mountains into the valleys then westward down the valley.

Table 3.3-3a summarizes the water balance for Boulder Flat, Maggie Creek, Marys Creek, Susie Creek, Willow Creek, and Rock Creek basins under pre-dewatering conditions prior to 1991. Precipitation and

mountain-front runoff are the main sources of recharge to the hydrologic system in the Boulder Valley area. Precipitation falling in the mountainous areas that does not infiltrate or evaporate in the mountains becomes the mountain-front runoff that recharges the groundwater system in the valley alluvium. The total estimated inflow to the hydrologic study area is approximately 445,000 acre-feet per year (afy), including 56,700 afy of direct recharge, 62,400 afy of mountain-front recharge and 25,900 afy of recharge from the Humboldt River into Boulder Flat. Of this, approximately 203,100 afy recharges the Willow Creek, Rock Creek, and Boulder Valley areas, and the remaining 151,900 afy recharges the Maggie Creek, Marys Creek, and Susie Creek areas. In the Boulder Flat area, an estimated 25,900 afy comes from infiltration of Humboldt River water, approximately 24,900 afy arrives as surface water in Rock Creek, and approximately 17,100 afy comes from groundwater underflow and adjacent basins within the CESA (Zhan 2008).

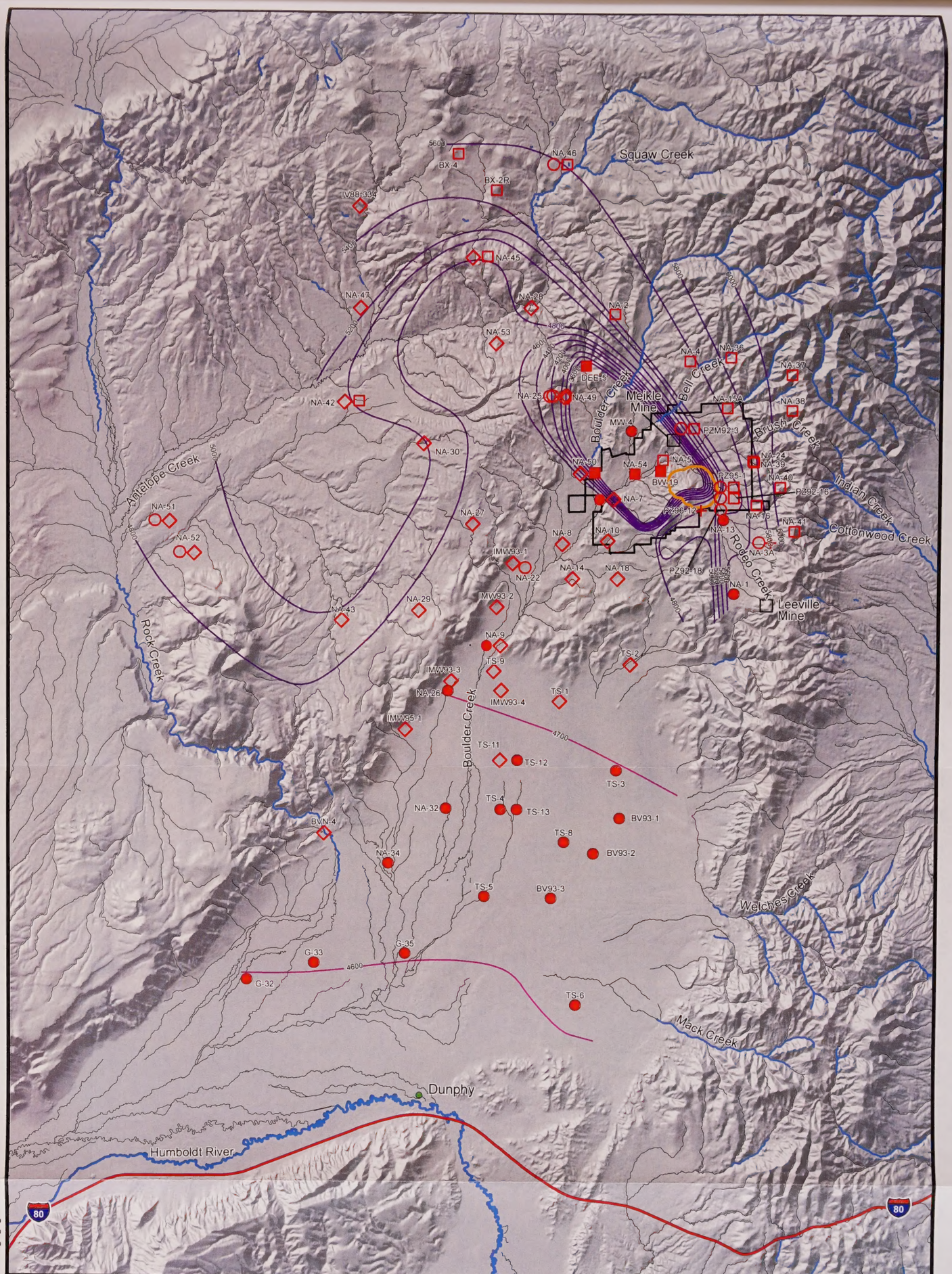
Discharge from groundwater comes from evapotranspiration by plants, subsurface outflow, discharge to springs and streams, and groundwater use through pumping. Evapotranspiration accounts for approximately 99,200 afy of outflow from the hydrologic study area (Zhan 2008). From Boulder Flat, an estimated 6,800 afy groundwater leaves the basin as groundwater outflow. An estimated 28,800 afy of discharge occurs from the Maggie Creek, Marys Creek, and Susie Creek Hydrographic Areas to the Humboldt River as stream flow. An estimated 11,500 afy of discharge occurs as groundwater outflow.

Current Groundwater Flow and Water Balance

The current water balance in Boulder Valley is affected by dewatering in the Betze Pit area and reinjection of water through the TS Ranch Reservoir and the use of excess flows through irrigation pivots. Natural recharge to the hydrologic system has not changed, but the redistribution of surface water and groundwater due to dewatering, sprinkler irrigation and evaporation, reinjection and evaporation has modified the water balance in Boulder Valley from prior to 1991. Also, water is lost to evaporation in the TS Ranch Reservoir. **Table 3.3-3b** shows the estimated current water balance for Boulder Valley and vicinity (Zhan 2008). For the project area in Boulder Flat, recharge from precipitation and mountain front run-off is approximately 19,100 afy. The total water influx to the basin from all sources is approximately 333,400 afy. The major sources of recharge are groundwater inflow, river leakage, and infiltration from the BGMI water management activities. Discharge due to evapotranspiration is approximately 106,500 afy from plants and crops combined, and approximately 63,500 afy due to mine pumping at the Goldstrike and Leeville mines. Willow Creek and Rock Creek basins are not affected by pumping, so recharge is from precipitation and river leakage, with discharge due to evapotranspiration along with surface water and groundwater outflow. Marys, Maggie, and Susie creeks are affected by mine dewatering at Gold Quarry, with increased outflows from the Marys Creek and Susie Creek basin, and decreased surface and groundwater outflow from Maggie Creek Basin.

3.3.1.5 Groundwater Rights

According to the Nevada State Engineer's records, there are approximately 234 groundwater rights and applications for groundwater rights on file in the hydrologic study area. These are presented in the BLM's Betze Project SEIS (2000a). This inventory does not include rights and applications for rights by BGMI or Newmont that are classified as mining and milling. Because water rights are not required for domestic wells, this inventory does not include all domestic watering wells that may exist in the hydrologic study area. Included in the inventory are five known water supply wells that are used for domestic or stock water. The area around Carlin most likely includes many private domestic water wells that are not included in the inventory.



3.3-8

LEGEND

- Monitoring Well Quaternary Alluvium/Colluvium Layer
- Monitoring Well Tertiary Carlin Formation Layer
- Monitoring Well Tertiary Volcanics Layer
- Monitoring Well Jurassic/Cretaceous Granodiorite Layer
- Monitoring Well Paleozoic Siltstones Layer
- Monitoring Well Paleozoic Limestones Layer
- Tertiary and Paleozoic Rock Potentiometric Surface Elevation
- Boulder Valley Alluvium Potentiometric Surface Elevation
- Goldstrike Mine Operations Boundary
- Betze Pit
- Perennial Stream Reach
- Stream (Intermittent or Ephemeral)

Source: BGMI 2007f.

N

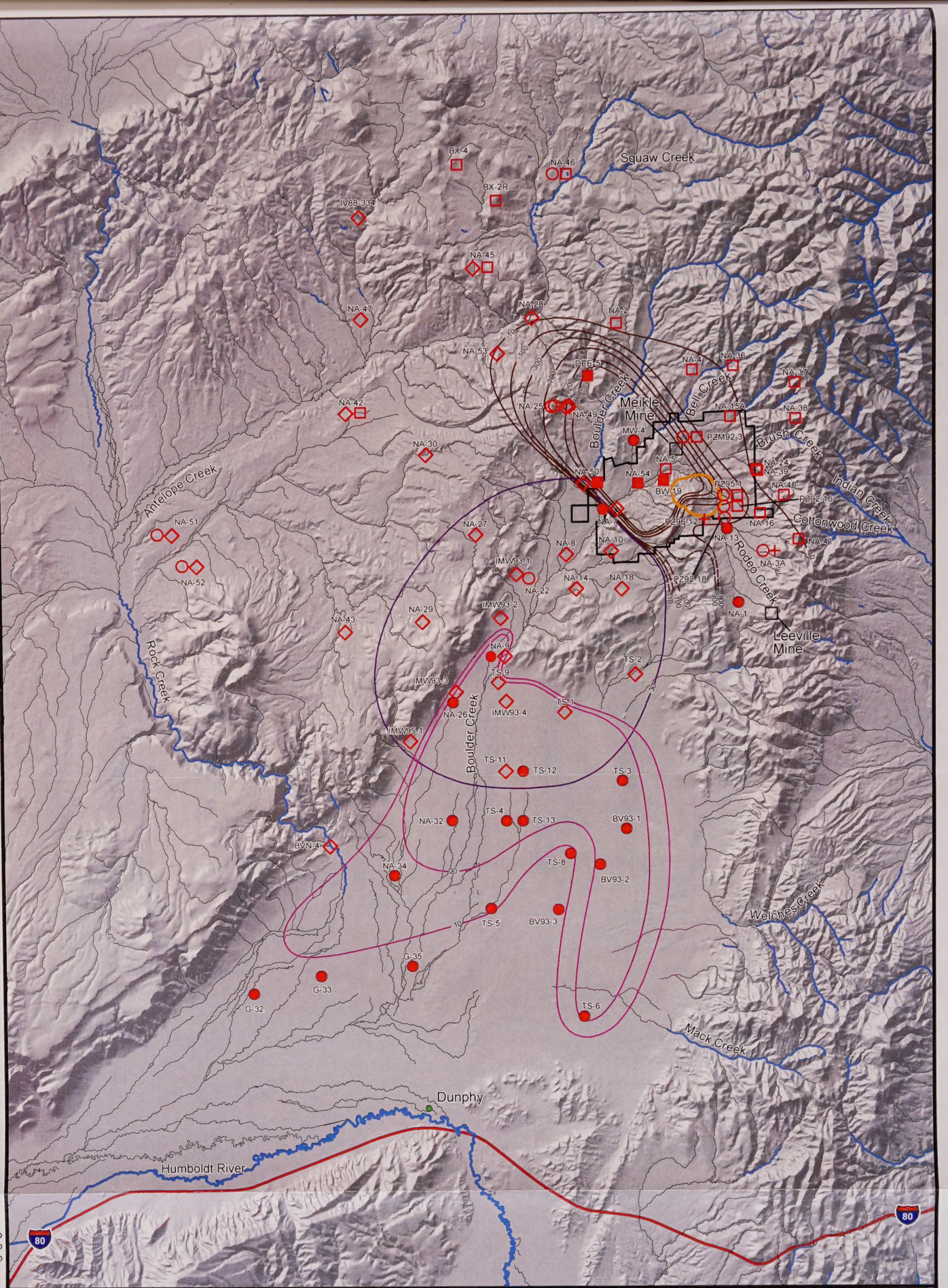
0 2.5 5 Miles

Betze Pit Expansion Project

Figure 3.3-2

Groundwater Elevation
Fourth Quarter 2006 and
First Quarter 2007

05/20/2008



3.3-9

Figure 3.3-3

Changes in Groundwater Elevation
Fourth Quarter 2006 and
First Quarter 2007

Betze Pit Expansion Project

LEGEND

- Monitoring Well Quaternary Alluvium/Colluvium Layer
- Monitoring Well Tertiary Carlin Formation Layer
- Monitoring Well Tertiary Volcanics Layer
- Monitoring Well Jurassic/Cretaceous Granodiorite Layer
- Monitoring Well Paleozoic Siltstones Layer
- Monitoring Well Paleozoic Limestones Layer
- Water Level Change In Tertiary Volcanics
- Water Level Change in Quaternary Alluvium/Colluvium
- Water Level Change In Paleozoic Bedrock Due To Pumping
- Goldstrike Mine Operations Boundary
- Betze Pit
- Perennial Stream Reach
- Stream (Intermittent or Ephemeral)

Source: BGMI 2007f.

N

0 2.5 5 Miles

06/25/2008

Table 3.3-3a Pre-mining Simulated Water Balance (acre-feet)

Sources	Willow Creek		Rock Creek		Boulder Flat		Marys Creek		Maggie Creek		Susie Creek		Total
	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	
Recharge													
Direct	14,000		9,800		11,200		1,500		13,800		6,400		6,400
Mountainfront		20,100		5,900		7,900		1,300		20,200		7,000	7,000
Groundwater inflow	600		6,800		17,100		4,300		3,400		1,500		1,500
Surface water inflow				21,000		24,900							24,900
River leakage													0
Humboldt					25,900								25,900
Other	12,400	13,300	12,000	10,000			3,500	5,900	29,400	25,700	5,400	7,300	77,200
Storage	8,800		5,400		32,700		1,600		10,400		3,000		3,000
TOTAL IN	35,800	33,300	34,000	36,900	113,500	39,600	10,900	7,200	57,100	45,900	16,400	14,400	445,000
Sinks													
Evapotranspiration													
Natural ET	11,400		1,000		68,300		2,500		12,500		3,500		3,500
Crop ET													
Runoff to Humboldt						100		100				300	300
Surface water outflow		21,000		24,900		13,000		3,700		16,500		8,600	8,600
Groundwater outflow	2,500		17,800		6,800		600		8,600		2,300		2,300
River leakage													
Humboldt							200		100		300		300
Other	13,300	12,400	10,000	12,000	6,800	26,600	5,900	3,500	25,700	29,400	7,300	5,400	158,300
Storage	8,700		5,200		31,700		1,700		10,200		3,000		3,000
TOTAL OUT	35,800	33,300	34,000	36,900	113,600	39,600	10,900	7,200	57,100	45,900	16,400	14,400	445,100

Note: Blank cells are not applicable.

Source: Zhan 2008.

Table 3.3-3b Current Simulated Water Balance July 2005 – June 2006 (acre-feet)

Sources	Willow Creek		Rock Creek		Boulder Flat		Marys Creek		Maggie Creek		Susie Creek		Total
	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	
Recharge													
Direct	14,000		9,800		11,200		1,500		13,800		6,400		6,400
Mountainfront		20,100		5,900		7,900		1,300		20,200		7,000	7,000
Groundwater inflow	600		7,100		37,900		4,000		15,200		1,700		1,700
Surface water inflow				21,000		24,900							24,900
River leakage													
Humboldt					25,900								25,900
Other	12,400	13,300	12,000	10,000			3,500	5,600	29,700	22,300	5,400	7,300	73,800
Storage	8,800		8,500		95,400		2,000		37,300		4,100		4,100
Infiltration													
Irrigation					25,200								25,200
Injection wells													
Reservoir					45,000								45,000
Pond					600								600
TOTAL IN	35,900	33,300	37,400	36,900	275,200	58,200	11,100	7,000	95,900	42,500	17,600	14,400	665,400
Sinks													
Evapotranspiration													
Natural ET	11,400		1,000		88,800		2,500		12,300		3,500		3,500
Crop ET					17,700								17,700
Runoff to Humboldt						100		100				300	300
Surface water outflow		21,000		24,900		13,100		3,400		12,800		8,600	8,600
Groundwater outflow	2,500		20,300		17,200		1,000		26,900		3,500		3,500
River leakage													
Humboldt							200		100		300		300
Other	13,300	12,400	10,000	12,000	25,300	34,100	5,600	3,500	22,300	29,700	7,300	5,400	180,900
Storage	8,700		6,100		62,800		1,700		10,200		3,000		3,000
Pumping													
Barrick pumping					33,300								33,300
Newmont pumping					30,200				24,200				24,200
Pumpback (diversion)						11,000							11,000
TOTAL OUT													**372,100**

Note: Blank cells are not applicable.

Source: Zhan 2008.

3.3.1.6 Seeps and Springs

Initially, two field investigations were undertaken to identify perennial seeps and springs located around the Goldstrike Mine (BLM 2000b). Both inventories were conducted in the fall to identify seeps and springs discharging groundwater at the low-flow time of the year. The first inventory was conducted in 1989 (JBR 1990) and covered an area within a 10-mile radius of the Goldstrike Mine. This inventory included the Boulder, Bell, Brush, and Rodeo Creek watersheds and identified 131 seeps and springs. The second inventory was conducted in 1993 (Riverside Technology, inc. [RTi] 1994) and covered approximately 600 square miles. This inventory included the Willow Creek, Rock Creek, and Antelope Creek watersheds and springs located in the northern, southern, and eastern portions of the Tuscarora Mountains. A total of 277 new seeps and springs were identified with perceivable flows and 211 seeps and springs with no flow. Spring inventories in the region around the Gold Quarry Mine (JBR 1992a) identified 200 seeps and springs. The most recent spring monitoring survey was completed by AATA (2007). This survey compiled spring flow rates and water quality.

Flows in springs identified in the region around the Goldstrike Mine, except for Green, Knob, and Sand Dune springs, ranged from less than 1 gpm to 140 gpm, with most having a discharge less than 3 gpm (BLM 2000a,b). Only four springs had flows greater than 10 gpm with 90 percent of the springs showing flows between 1 and 3 gpm during the fall months. Within a 10-mile radius of the Gold Quarry Mine, seeps and springs primarily have flow rates less than 5 gpm; only 12 springs exceeded 5 gpm, and 4 of these springs had flows greater than 50 gpm.

Springs inventoried in the northern part of the Tuscarora Mountains, Boulder Flat, Rock Creek, and Willow Creek basins had temperatures ranging from 38 to 78°F. No springs with temperatures greater than 90°F were identified. In the Maggie Creek, Marys Creek, and Susie Creek basins, five hot springs were identified (BLM 2000b).

3.3.1.7 Groundwater Quality

The NAC 445A.453 establishes primary water quality standards, and NAC 445A.455 establishes secondary standards for water quality. Nevada water standards applicable to this SEIS are summarized in **Appendix B**, **Table B-1**. Primary standards are based on the potential use of groundwater for drinking water and are established to protect human health; the secondary standards are for aesthetic qualities. Because groundwater in the project area has the potential to be used for drinking water, the Nevada primary standards would apply to mine-related activities that affect groundwater.

Groundwater quality near the Goldstrike Mine is based on sampling conducted for the original Betze Project EIS (BLM 1991a,b) and from 61 wells sampled as part of the Betze-Screamer Pit Lake Study (Radian International and Baker Consultants 1997). In addition, 36 regional wells were selected to characterize the groundwater in the Boulder Valley alluvium and Tertiary volcanics (BGMI 1998). The general groundwater chemistry for the major hydrostratigraphic units is presented in **Appendix B**, **Table B-2**, and is shown on a trilinear diagram in **Figure B-2**. In **Appendix B**, **Table B-3** summarizes the groundwater quality in the first-quarter 2007 round of sampling of monitoring wells in Boulder Valley. BGMI routinely samples groundwater quality as part of its Boulder Valley Monitoring Plan (BVMP), and the data in **Table B-3** come from the latest round of sampling under the BVMP (BGMI 2007c).

The Paleozoic marine clastic rocks near the Betze Pit primarily contain calcium-magnesium-bicarbonate water with elevated sulfate and silica. The total dissolved solids (TDS) in this water are approximately 305 mg/L, and pH is around 7.6 standard units. The Paleozoic marine carbonate rocks contain a strong calcium-bicarbonate water type that is relatively low in sodium and sulfate; average TDS are approximately 566 mg/L, and average pH is around 6.75 standard units. The Jurassic-Tertiary igneous rocks contain calcium-sulfate water with elevated chloride, and TDS of approximately 392 mg/L. Samples from the Tertiary volcanic rocks show a mean TDS of 375 mg/L in a calcium-sodium bicarbonate water. The Tertiary older alluvial rocks

(Carlin Formation) contain a calcium-bicarbonate water with silica and sulfate. Water in the Quaternary alluvium is also mainly a calcium-sodium bicarbonate water with TDS of around 330 mg/L.

Betze Pit Area

Groundwater sampled near the Betze Pit area can be divided into two general types: 1) calcium-bicarbonate water found in the Paleozoic marine carbonate rocks; and 2) calcium-bicarbonate water with elevated silica, manganese, and chloride found in the Carlin Formation and the Paleozoic marine clastic rocks. In addition, arsenic, barium, boron, fluoride, iron, and manganese are commonly detected in groundwater near the Betze Pit. Arsenic concentrations average around 0.06 mg/L and are highest in the Paleozoic marine clastic rocks and the Jurassic-Tertiary intrusive rocks. Barium, boron, and fluoride concentrations are elevated in the thermal water found in the Paleozoic marine carbonate rocks and the Carlin Formation. The mean concentration of iron is highest (1.6 mg/L) in the Carlin Formation. Manganese concentrations are approximately an order of magnitude greater in the Paleozoic marine clastic rocks and the intrusive rocks than in other formations. Average antimony concentrations are between 0.03 and 0.04 mg/L in the Paleozoic marine carbonate rocks and the intrusive rocks. The average concentration of zinc in groundwater near the pit is approximately 0.02 mg/L.

Boulder Valley Area

Most groundwater samples from the alluvium and volcanics of Boulder Valley were within Nevada drinking water standards for major ions and trace metals. Six groundwater samples exceeded the standard for pH, and drinking water standards for TDS were exceeded in 24 samples. Trace metals detected in the alluvium include arsenic, barium, boron, copper, fluoride, iron, lead, manganese, selenium, and zinc. Exceedences of Nevada drinking water standards for trace metals were infrequent but were detected for arsenic, iron, and manganese. The maximum concentration for arsenic was 0.14 mg/L, for iron was 100 mg/L, and for manganese was 2.8 mg/L. Groundwater samples from volcanic rocks detected aluminum, arsenic, barium, boron, chromium, copper, fluoride, iron, lead, manganese, selenium, thallium, and zinc; concentrations of aluminum, arsenic, fluoride, iron, lead, and manganese slightly exceeded drinking water standards. The maximum concentrations follow: aluminum was 0.7 mg/L, arsenic was 0.21 mg/L, fluoride was 3.0 mg/L, iron was 59 mg/L, lead was 0.018 mg/L, and manganese was 2.9 mg/L.

Current groundwater quality data from monitoring wells and springs in Boulder Valley (BGMI 2007f) indicate arsenic concentrations up to 0.04 mg/L and barium up to 0.104 mg/L. The TDS for monitoring wells ranges from 159 to 571 mg/L. Sulfate is below 100 mg/L, and the waters are calcium-sodium bicarbonate dominated. The Boulder Valley springs TDS range from 286 to 357 mg/L, and waters are dominated by calcium bicarbonate. Mean concentrations of arsenic are approximately 0.01 mg/L, and are barium approximately 0.1 mg/L. These results indicate the spring waters are similar in major cation chemistry to the groundwater in the monitoring wells. Boulder Valley monitoring data (BGMI 2007f) are summarized in **Table B-3** in **Appendix B**.

Seeps and Springs Water Quality

Measured temperatures for inventoried springs ranged from 38 to 78°F. This temperature range is strongly influenced by ambient air temperature because most of the springs sampled had flow rates less than 3 gpm. No hot springs were encountered during the inventories. The pH in 399 sampled springs ranged from 6.4 to 8.9 standard units, and two springs in upper Antelope Creek located below old mine workings had pH values between 3.0 and 4.0 standard units. TDS in most sampled springs ranged from 32 to 550 mg/L (RTi 1994). The springs with low TDS tended to be located at the higher elevations in the Tuscarora Mountains. Tritium samples taken from selected springs showed that water discharging from springs on the eastern slope of the Tuscarora Mountains have low residence times, while tritium concentrations in samples from the upper Antelope Creek-Squaw Creek area suggest the groundwater is pre-1954 in age. Other samples taken in the

hydrologic study area were intermediate between tritium concentrations found in pre-1954 and very recent water, suggesting a mixing of older and younger waters.

A recent survey of seeps and springs by AATA (2007) found flow rates in 2006 ranging from less than 1 gpm to a maximum of 281 gpm (not including Rock Creek). The results of this survey are summarized in **Tables B-4** through **B-6** in **Appendix B**. Most springs had flow rates less than 5 gpm. The TDS ranged from a low of 45 mg/L in Beaver Creek to a high of 478 mg/L in Brush Creek. Each drainage basin had its own distinctive range in TDS values and flow rates. The pH in the sampled springs was mainly between 7.0 and 8.0 standard units. Most arsenic concentrations were less than 0.01 mg/L, but up to 0.0781 mg/L was recorded. The springs were dominated by bicarbonate water. Sulfate concentrations were generally less than 100 mg/L but ranged up to 154 mg/L. The survey found that only two springs in Boulder Creek (springs #6 and #88) showed definite impact from mine dewatering. All other springs often showed a relationship between precipitation and flow rate but no measurable impact due to mine dewatering at the Betze Pit.

3.3.1.8 Waste Rock Geochemistry

Exposure of rocks to air and water during and after mining may cause increased weathering reactions. These weathering reactions could result in the mobilization of constituents from the exposed rocks, potentially affecting surface and groundwater resources. A key concern related to mine waste rock is the potential for acid generation through oxidation of sulfide minerals such as pyrite. Acid generated by sulfide mineral oxidation and associated metals releases from waste rock can, in some cases, affect water quality.

Characterization of waste rock from the Betze Pit and proposed laybacks was described by Schafer (2008b). Waste rock was characterized by determining its acid generation potential using static acid-base accounting (ABA) analyses and geochemical composition through whole-rock chemical analyses. Static ABA measurements indicate whether waste rock is a likely net producer or consumer of acid that is generated by sulfide oxidation. Whole-rock chemical analyses measure the concentrations of constituents in the rocks and indicate potential sources of constituents of concern. Leachate from the waste rock was characterized by performing kinetic tests that included both humidity cell and column leach tests. These leachate characterization results were used to establish the expected variations in leachate chemistry over time.

Static ABA tests estimate the acid producing potential of a material based on the acid generating and acid neutralizing minerals present in the sample. Acid-generating potential is expressed as AGP, and acid-neutralizing potential is expressed as ANP. The difference between the ANP and the AGP is the NNP. If the NNP is a negative less than -20 kilograms per ton of calcium carbonate (kg/t $CaCO_3$), the material is often classified as having the PAG. If the NNP is greater than 20 kg/t $CaCO_3$, then the material is often classified as non-acid generating (NAG). Materials that fall between these two values are often classified as being "Uncertain" as to their potential for acid generation (U.S. Environmental Protection Agency [USEPA] 1994).

The method of waste rock classification used by BGMI for static ABA test results divides materials into two categories based on NNP and percent sulfide sulfur. Under the BGMI method, waste rock is classified as PAG if the NNP is less than 0.0 tons per kiloton (t/Kt) $CaCO_3$ and the sulfide sulfur is greater than 0.3 percent. If the waste rock has an NNP greater than or equal to 0 t/Kt and a sulfide sulfur of less than 0.3 percent, then the material is classified as NAG. The NNP is defined as the ANP minus the AGP and is expressed in $CaCO_3$ (t/Kt).

The BLM classifies waste rock based on static ABA tests as NAG if the NNP is equal to or greater than 20 t/Kt and the ANP/AGP ratio is 3:1 or greater (BLM IM No. 96-79 [BLM 1996]). Any material that does not meet these criteria is classified as "Uncertain" and considered potentially acid generating and must be evaluated by kinetic methods such as humidity cell tests or column leach tests to determine the potential for acid generation. A method commonly used in western mines that is a modification of the BLM guidelines assumes that if the NNP is less than -20 t/Kt, the material is PAG. Under this modification, any material that falls between an NNP

of -20 t/Kt and an NNP of +20 t/Kt is classified as "Uncertain" for potential acid generation. This material is subjected to kinetic tests to determine the potential for acid generation. Materials that have an NNP less than -20 t/Kt also are subjected to kinetic tests.

The BGMI method for classifying waste rock from static ABA tests is similar to, but not directly comparable to the BLM guidelines. **Tables 3.3-4** through **Table 3.3-6** present data from Schafer (2008a) with the BGMI method and the BLM method for classifying rocks by the static ABA test results displayed together in the same table. **Table 3.3-4** presents the 1997 column test samples. This table shows that out of 15 samples, 5 of the samples (33 percent) classified as NAG by BMGI would be classified as Uncertain by the BLM. Also, this table shows that two of the samples (13.3 percent) classified as NAG by the BGMI method had pH values below 5.0 standard units, suggestive of potential acid generation. On this same table, the BLM method of classification had no difference in the classification of NAG rocks. **Table 3.3-5** presents 2002 column test charge samples. In this table, four of the samples (18.2 percent) classified as NAG by the BGMI method would be classified as Uncertain by the BLM method. No rocks classified as NAG under the BGMI method had a pH of less than 5.0 in this table.

Schafer (2008b) summarized the results of BGMI's extensive humidity cell and column leach tests of waste rock that would be sent to either the proposed Clydesdale Waste Rock Facility, the Bazza Waste Rock Facility, or disposed of in the proposed expanded Betze Pit. BGMI has performed static ABA tests on over 30,000 samples from exploration boreholes and on over 100,000 blasthole pulps since the inception of mining at Goldstrike. **Table 3.3-6** presents a condensed summary of BGMI kinetic test data (Schafer 2008b, Table A-2) along with the BLM and BGMI static ABA classifications of the samples and the BGMI acid risk classification of kinetic results. The BGMI acid risk classification method for determining PAG from kinetic data involves pH, sulfate, and the "acidity" indicated in the test data, as summarized at the bottom of **Table 3.3-6**. BGMI considers a rock to be PAG from kinetic data if the pH is greater than 5.0 standard units, and the sulfate is greater than 20 mg/kg with an NNP from the static ABA test of greater than -5.0 t/Kt. Acid generating is defined as a pH of greater than 5.0 standard units with sulfate greater than 20 mg/kg, but with an NNP of less than -5.0 t/Kt. Strongly acid generating is defined as having a pH in the kinetic data of less than 5.0 standard units. The BGMI method for classifying kinetic data defines NAG as having a pH of greater than 5.0 standard units and sulfate less than 20 mg/kg. The BLM does not have guidelines for classifying kinetic data into varying degrees of acid generation. For the purpose of comparing the BLM and BGMI methods, any level of acid generation in the BGMI acid risk classification scheme is considered as indicating the potential for acid generation.

An analysis of **Table 3.3-6** shows rocks classified as NAG by BGMI had some degree of potential acid generation in approximately 22.2 percent of the samples for which there was NNP data. For samples where the pH was below 5.0 standard units, the BGMI NAG classification differed for 7.9 percent of the samples. For samples classified as PAG by the BGMI method, there was a 20.0 percent difference in classification in that the PAG samples were classified as NAG by the kinetic data. Using the BLM criteria for classifying rocks from the static ABA test results, rocks classified as NAG by the BLM method indicated some degree of potential acid generation in 20.8 percent of the samples. For samples where the kinetic data showed a pH of less than 5.0 standard units, the BLM method classified these rocks as NAG 8.3 percent of the time.

A review of **Tables 3.3-4** through **3.3-6** indicates that neither the BGMI method nor the BLM method for classifying waste rock from static ABA test data is consistent 100 percent of the time. Both methods differ in the classification of NAG rocks approximately 8 percent of the time based on kinetic data showing a pH of less than 5.0 standard units for the last 5 weeks of testing for rocks classified as NAG. The BGMI method has rocks classified as NAG showing some degree of potential acid generation based on the kinetic data approximately 20 percent of the time. The BLM method also differed in the classification of NAG rocks approximately 20 percent of the time in terms of some potential for acid generation in the kinetic data.

Table 3.3-4 Lithology, Static ABA, and Column Test Data – 1997 Column Samples

Column Number	Bulk Sample Label	Formation	Paste pH (SU)	AGP (t/Kt)	ANP (t/Kt)	NNP (t/Kt)	ANP: AGP	BGMI Class	BLM Class	Column pH (SU)	Column EC (µmhos/cm)
16	1-CAR	Carlin	7.1	0.6	2.5	1.9	4.17	NAG	Uncertain	7.53/7.72	3,940/182
17	4-GD	Intrusive	7.6	10	65	55	6.50	NAG	NAG	7.61/7.56	2,950/172
18	5B-GD	Intrusive	7.8	10	82.5	72.5	8.25	NAG	NAG	7.75/7.28	2780/97
19	7-ARG	Unox Rodeo Creek	3.3	43.1	4.2	-38.9	0.10	PAG	Uncertain (PAG)	2.33/2.62	14,400/1,410
20	7-SIL	Unox Rodeo Creek	2.5	24.4	31.7	7.3	1.30	NAG	Uncertain	2.33/2.92	13,500/1,050
21	8-DRC	Ox Rodeo Creek	2.9	0.3	0.8	0.5	2.67	NAG	Uncertain	6.67/6.5	2,670/77.9
22	8-LVIN	Unox Vinini	6.1	23.1	90	66.9	3.90	NAG	NAG	6.82/7.79	18,200/773
23	8-MVIN	Unox Vinini	7.4	0.3	197.4	197.1	658.00	NAG	NAG	7.66/7.53	3,270/255
24	9-VIN	Ox Vinini	7.3	0.3	4.2	3.9	14.00	NAG	Uncertain	7.25/6.44	693/17.6
25	12-POX	Ox Popovich	7.2	0.9	4.1	3.2	4.56	NAG	Uncertain	6.77/6.32	1,560/23.7
26	13-POC	Unox Popovich	5.9	60	58.4	-1.6	0.97	PAG	Uncertain	6.36/7.41	11,400/414
27	13-POS	Unox Popovich	4.1	62.5	4.3	-58.2	0.07	PAG	Uncertain (PAG)	3.26/3.1	10,500/948
28	14-CZH	Contact zone rock	2.6	94.4	4.3	-90.1	0.05	PAG	Uncertain (PAG)	1.88/2.61	33,500/2,020
29	14-CZS	Contact zone rock	5.6	47.5	14.2	-33.3	0.30	PAG	Uncertain (PAG)	6.29/7.03	3,980/490
30	15-OR	Unox Popovich	3.3	58.1	4.2	-53.9	0.07	PAG	Uncertain (PAG)	1.97/2.59	16,200/1,530

Notes: BLM Classification is modified to include PAG for NNP <+ -20 t/Kt and this is shown in ( ).
BLM Uncertain classification applies to NNP less than +20 t/Kt. Above 20 t/Kt rock is classified as NAG.
Column pH and Column EC have initial and final pore volume results displayed as initial/final.
SU = Standard Units; t/Kt = Tons/Kiloton $CaCO_3$; EC = Electrical Conductivity (specific conductance).

Source: Schafer 2008b.

Table 3.3-5 2002 Column Test Charge Samples

Number	Rock Type	Source	pH (SU)	ANP (t/Kt)	AGP (t/Kt)	NNP (t/Kt)	ANP:AGP	BGMI Class	BLM Class
3	Popovich	Highwall	8.08	217	42.5	174.5	5.11	NAG	NAG
7	Carlin	Highwall	8.25	45	3.4	41.6	13.24	NAG	NAG
8	Diorite	Highwall	8.03	158	25.9	132.1	6.10	NAG	NAG
10	Roberts Mtn Fm	Highwall	7.82	42	31.3	10.7	1.34	NAG	Uncertain
15	Vinini Fm	Highwall	7.79	20	1.9	18.1	10.53	NAG	Uncertain
16	Calc-silicates	Waste Rock	6.8	265	5.6	259.4	47.32	NAG	NAG
17	Calc-silicates	Waste Rock	8.61	206	26.6	179.4	7.74	NAG	NAG
18	Calc-silicates	Waste Rock	8.55	633	20.3	612.7	31.18	NAG	NAG
19	Diorite	Waste Rock	2.44	13	75	-62	0.17	PAG	Uncertain (PAG)
20	Diorite	Waste Rock	3.21	16	174.7	-158.7	0.09	PAG	Uncertain (PAG)
21	Diorite	Waste Rock	5.56	65	4.7	60.3	13.83	NAG	NAG
23	Rodeo Ck Fm	Waste Rock	3.85	4	52.5	-48.5	0.08	PAG	Uncertain (PAG)
24	Rodeo Ck Fm	Waste Rock	4.02	7	53.4	-46.4	0.13	PAG	Uncertain (PAG)
28	Popovich	Waste Rock	3.55	29	58.1	-29.1	0.50	PAG	Uncertain (PAG)
3	Popovich	Highwall	8.08	217	42.5	174.5	5.11	NAG	NAG
7	Carlin	Highwall	8.25	45	3.4	41.6	13.24	NAG	NAG
8	Diorite	Highwall	8.03	158	25.9	132.1	6.10	NAG	NAG
10	Roberts Mtn Fm	Highwall	7.82	42	31.3	10.7	1.34	NAG	Uncertain
15	Vinini Fm	Highwall	7.79	20	1.9	18.1	10.53	NAG	Uncertain
16	Calc-silicates	Waste Rock	6.8	265	5.6	259.4	47.32	NAG	NAG
17	Calc-silicates	Waste Rock	8.61	206	26.6	179.4	7.74	NAG	NAG
18	Calc-silicates	Waste Rock	8.55	633	20.3	612.7	31.18	NAG	NAG

Notes: BLM Classification is modified to include PAG for NNP <+ -20 t/Kt and this is shown in ( ).
BLM Uncertain classification applies to NNP less than 20 t/Kt.
BLM Classification has NAG for all rocks with NNP at >= +20 t/Kt.
SU = Standard Units; t/Kt = tons/kiloton $CaCO_3$

Source: Schafer 2008b.

Table 3.3-6 BGMI Humidity Cell Test Summary with BGMI and BLM Waste Rock Classifications

Humidity Cell	Lithology	pH (SU)	Sulfate (mg/L)	AGP (T/Kt)	ANP (T/Kt)	NNP T/Kt)	BGMI Acid Risk Class	BGMI Waste Rock Class	BLM Waste Rock Class
B-10	Drc-ox	7.09	22	115.6	48.3	-67.3	Acid-generating	PAG	Uncertain (PAG)
WR-2P	Dp-Unox	6.65	332.4	19.4	3.8	-15.6	Acid-generating	PAG	Uncertain
B-3	Dp-Unox	6.51	13.2	21.6	7.2	-14.4	Non-acid generating	PAG	Uncertain
B-5	Dp-Unox	6.35	12	7.5	.1	-7.4	Non-acid generating	PAG	Uncertain
B-1	Drc-ox	5.7	129	1.9	1.8	-0.1	Non-acid generating	PAG	Uncertain
WR-3P	Jd	7.09	11.2	.6	40	39.4	Non-acid generating	NAG	NAG
WR-1P	CZR	6.69	187.2	1.6	46.4	44.8	Non-acid generating	NAG	NAG
WR-7P	Jd	6.39	194	51.9	122.0	70.1	Non-acid generating	NAG	NAG
B-12	Dp-Unox	7.14	10	15.3	125.0	109.7	Non-acid generating	NAG	NAG
WR-5P	Jd	6.35	493.2	30	171	141	Non-acid generating	NAG	NAG
WR-12P		6.5	10	14.7	191	176.3	Non-acid generating	NAG	NAG
B-9	Dp-Unox	6.8	101.4	14.4	7.2	-7.2	Potentially acid generating	PAG	Uncertain
WR-13P		5.16	25	15.3	15	-0.3	Potentially acid generating	PAG	Uncertain
B-2	Dp-Unox	7.04	50.8	0.6	2.0	1.4	Potentially acid generating	NAG	Uncertain
B-14	Dp-Unox	6.68	21.6	25.9	42.7	16.5	Potentially acid generating	NAG	Uncertain
WR-6P	Jd	6.05	53.8	41.3	224	182.8	Potentially acid generating	NAG	NAG
WR-8P	Dp-Unox	3.33	487.6	59.4	4.8	-54.6	Strongly acid generating	PAG	Uncertain (PAG)
B-6	Dp-Unox	3.38	737.6	62.2	8	-54.2	Strongly acid generating	PAG	Uncertain (PAG)
B-13	Dp-Unox	4.99	62	52.2	75.1	22.6	Strongly acid generating	NAG	NAG
BP-16	Jd	6.58	10	1.5	5	3.5	Non-acid generating	NAG	Uncertain
BP-2	Jd	7.0	13.4	6.3	10	3.7	Non-acid generating	NAG	Uncertain
BP-72	Dp-ox	7.5	13	3.1	20	16.9	Non-acid generating	NAG	Uncertain
BP-17	Jd	6.36	10	.9	30	29.1	Non-acid generating	NAG	NAG
BP-38	Jd	6.88	121.6	82.8	115.1	32.3	Non-acid generating	NAG	NAG
BP-70	*Jd*	*6.958*	*10*	*5.2*	*90.0*	84.8	Non acid-generating	NAG	NAG
BP20	*CZR*	*7.5*	*10.6*	*2.3*	*110.0*	*107.8*	Non acid-generating	NAG	NAG
BP-21	*CZR*	*3.92*	*275*	*103.4*	*20.0*	*-83.4*	Strongly acid-generating	PAG	Uncertain (PAG)
BP-58	*CZR*	*2.79*	*1049.6*	*119.1*	*65.1*	*-54.0*	Strongly acid-generating	PAG	Uncertain (PAG)
BP-74	*Jd*	*3.024*	*633.4*	*72.2*	*20.0*	*-52.2*	Strongly acid-generating	PAG	Uncertain (PAG)
BP-67	*Dp-Unox*	*4.62*	*200.2*	*56.9*	*10.0*	*-46.9*	Strongly acid-generating	PAG	Uncertain (PAG)
BP-55	*CZR*	*3.902*	*134.8*	*47.5*	*5.0*	*-42.5*	Strongly acid-generating	PAG	Uncertain (PAG)
BP-28	*CZR*	*3.164*	*466.4*	*41.6*	-	*-41.6*	Strongly acid-generating	PAG	Uncertain (PAG)
BP-30	*Drc-ox*	*2.996*	*720.8*	*45.9*	*10.0*	*-35.9*	Strongly acid-generating	PAG	Uncertain (PAG)
BP-29	*CZR*	*4.386*	*78.8*	*8.8*	-	*-8.8*	Strongly acid-generating	NAG	Uncertain
B-101	*Drc-ox*	*7.216*	*12.8*	-	-	-	Strongly acid-generating		
B-102	*Drc-ox*	*8.348*	*11.8*	-	-	-	Non acid-generating		
B-106	*Drc-Unox*	*5.742*	*40.2*	-	-	-			

Table 3.3-6 BGMI Humidity Cell Test Summary with BGMI and BLM Waste Rock Classifications

Humidity Cell	Lithology	pH (SU)	Sulfate (mg/L)	AGP (T/Kt)	ANP (T/Kt)	NNP T/Kt)	BGMI Acid Risk Class	BGMI Waste Rock Class	BLM Waste Rock Class
B-110	*Dp-Unox*	*5.304*	*190.8*	-	-	-			
B-111	*Dp-Unox*	*3.554*	*375.6*	-	-	-	Strongly acid-generating		
B-112	*Dp-Unox*	*3.872*	*391.4*	-	-	-	Strongly acid-generating		
BP-11	*Dp-Unox*	*4.60*	86	*56.6*	*5.0*	*-51.6*	Strongly acid-generating	PAG	Uncertain (PA
BP-7	*Jd*	*5.15*	129.5	*150.9*	-	*-150.9*	Strongly acid-generating	PAG	Uncertain (PA
BP-1	*Jd*	*6.808*	*10*	*20.1*	*5.0*	*-15.1*	Non acid-generating	PAG	Uncertain
BP-27	*Drc-ox*	*6.758*	*10*	*14.1*	*5.0*	*-9.1*	Non acid-generating	PAG	Uncertain
BP-15	*Jd*	*6.778*	*10*	*12.0*	*5.0*	*-7.0*	Non acid-generating	PAG	Uncertain
BP-53	*CZR*	*6.65*	*10*	*16.1*	*10.0*	*-6.1*	Non acid-generating	PAG	Uncertain
BP-50	*Drc-ox*	*6.488*	*10*	*4.5*	-	*-4.5*	Non acid-generating	NAG	Uncertain
BP-49	*Drc-ox*	*6.62*	*11*	*17.7*	*15.0*	*-2.7*	Non acid-generating	PAG	Uncertain
BP-31	*CZR*	*6.728*	*10*	*2.2*	-	*-2.2*	Non acid-generating	NAG	Uncertain
BP-54	*CZR*	*6.984*	*10.4*	*9.9*	*10.0*	*0.1*	Non acid-generating	NAG	Uncertain
BP-26	*Drc-ox*	*6.8*	10	*8.0*	*10.0*	*2.0*	Non acid-generating	NAG	Uncertain
BP-18	*Jd*	*6.762*	*10*	*4.3*	*10.0*	*5.7*	Non acid-generating	NAG	Uncertain
BP-76	*Drc-ox*	*6.484*	*10*	*4.0*	*10.0*	*6.0*	Non acid-generating	NAG	Uncertain
BP-91	*Drc-ox*	*6.986*	*10*	*5.3*	*15.0*	*9.7*	Non acid-generating	NAG	Uncertain
BP-65	*Drc-ox*	*6.256*	*10*	*9.8*	*25.0*	*15.2*	Non acid-generating	NAG	Uncertain
BP-98	*Dp-Unox*	*6.824*	*10*	*2.8*	*20.0*	*17.2*	Non acid-generating	NAG	Uncertain
BP-14	*Jd*	*6.78*	10	*15.3*	*55.0*	*39.7*	Non acid-generating	NAG	NAG
BP-94	*Drc-unox*	*7.384*	*11*	*16.6*	*175.2*	*158.6*	Non acid-generating	NAG	NAG
BP-52	*CZR*	*4.846*	*616.4*	*183.8*	*25.0*	*-158.8*	Strongly acid generating	PAG	Uncertain (PA
BP-86	*Dp-Unox*	*3.012*	*532*	*74.7*	*15.0*	*-59.7*	Strongly acid generating	PAG	Uncertain (PA
BP-82	*CZR*	*3.562*	*604*	*52.2*	-	*-52.2*	Strongly acid generating	PAG	Uncertain (PA
BP-81	*Drc-unox*	*2.872*	*1277.2*	*60.3*	*20.0*	*-40.3*	Strongly acid generating	PAG	Uncertain (PA
BP-87	*Drc-unox*	*2.896*	*610.8*	*51.9*	*15.0*	*-36.9*	Strongly acid generating	PAG	Uncertain (PA
BP71	*CZR*	*3.846*	*543.2*	*73.8*	*40.0*	*-33.8*	Strongly acid generating	PAG	Uncertain (PA
BP100	*Jd*	*3.444*	*182*	*43.1*	*25.0*	*-18.1*	Strongly acid generating	PAG	Uncertain
BP77	*Drcunox*	*4.263*	*119.4*	*15.7*	*5.0*	*-10.7*	Strongly acid generating	PAG	Uncertain
BP89	*Dp-Unox*	*3.88*	*75.6*	*55.0*	*190.2*	*135.2*	Strongly acid generating	NAG	NAG
B105	*Jd*	*7.888*	*10.8*	-	-	-	Non acid-generating		
B103	*Drc-ox*	*7.57*	*12*	-	-	-	Non acid-generating		
BP56	*CZR*	*5.83*	*22*	*34.7*	-	*-34.7*	Acid generating	PAG	Uncertain (PA
BP5	*Drc-ox*	*5.97*	*59.8*	*57.8*	*25.0*	*-32.8*	Acid generating	PAG	Uncertain (PA
BP3	*CZR*	*5.972*	*83*	*30.3*	*20.0*	*-10.3*	Acid generating	PAG	Uncertain
BP40	*Drc-ox*	*6.034*	*14.6*	*13.6*	-	*-13.6*	Non acid-generating	PAG	Uncertain
BP51	*Drc-ox*	*6.248*	*10*	*13.3*	*5.0*	*-8.3*	Non acid-generating	PAG	Uncertain

Table 3.3-6 BGMI Humidity Cell Test Summary with BGMI and BLM Waste Rock Classifications

Humidity Cell	Lithology	pH (SU)	Sulfate (mg/L)	AGP (T/Kt)	ANP (T/Kt)	NNP T/Kt)	BGMI Acid Risk Class	BGMI Waste Rock Class	BLM Waste Rock Class
BP80	*CZR*	*6.336*	*601*	*43.8*	*40.0*	*-3.8*	Non acid-generating	PAG	Uncertain
BP13	*Jd*	*6.554*	*10*	*6.4*	*20.0*	*13.6*	Non acid-generating	NAG	Uncertain
BP73	*CZR*	*6.59*	*106*	*54.7*	*75.1*	*20.4*	Non acid-generating	NAG	NAG
BP19	*Jd*	*6.966*	*10*	*1.8*	*25.0*	*23.2*	Non acid-generating	NAG	NAG
BP84	*Dp-Unox*	*6.774*	*27.4*	*19.8*	*55.0*	*35.2*	Non acid-generating	NAG	NAG
BP34	*Jd*	*7.336*	*24.8*	*46.6*	*100.1*	*53.5*	Non acid-generating	NAG	NAG
BP41	*Dp-ox*	*6.762*	*25*	*4.4*	*65.1*	*60.7*	Non acid-generating	NAG	NAG
BP64	*Jd*	*6.76*	*25*	*46.6*	*110.1*	*63.5*	Non acid-generating	NAG	NAG
BP79	*CZR*	*6.666*	*30*	*26.4*	*90.1*	*63.7*	Non acid-generating	NAG	NAG
BP23	*CZR*	*6.448*	*33.4*	*26.3*	*90.1*	*63.8*	Non acid-generating	NAG	NAG
BP24	*CZR*	*5.11*	*165.4*	*24.7*	*90.1*	*65.4*	Non acid-generating	NAG	NAG
BP25	*CZR*	*6.376*	*181.4*	*49.4*	*115.1*	*65.7*	Non acid-generating	NAG	NAG
BP42	*CZR*	*7.372*	*27.2*	*67.5*	*135.1*	*67.6*	Non acid-generating	NAG	NAG
BP45	*Dp-Unox*	*7.14*	*142.2*	*56.3*	*125.1*	*68.9*	Non acid-generating	NAG	NAG
BP47	*CZR*	*7.346*	*36.4*	*42.8*	*120.1*	*77.3*	Non acid-generating	NAG	NAG
BP39	*Jd*	*7.226*	*44.2*	*57.2*	*135.1*	*77.9*	Non acid-generating	NAG	NAG
BP22	*CZR*	*6.59*	*256.8*	*16.2*	*95.0*	*78.8*	Non acid-generating	NAG	NAG
BP75	*CZR*	*6.766*	*153*	*50.0*	*145.1*	*95.1*	Non acid-generating	NAG	NAG
BP60	*Jd*	*6.95*	*48.4*	*45.6*	*145.1*	*99.5*	Non acid-generating	NAG	NAG
BP32	*Jd*	*7.146*	*41.6*	*40.3*	*145.1*	*104.8*	Non acid-generating	NAG	NAG
BP61	*CZR*	*6.544*	*218*	*88.8*	*200.2*	*111.5*	Non acid-generating	NAG	NAG
BP43	*Jd*	*7.558*	*15.6*	*43.4*	*170.1*	*126.7*	Non acid-generating	NAG	NAG
BP62	*CZR*	*6.768*	*153*	*80.3*	*225.2*	*144.9*	Non acid-generating	NAG	NAG
BP9	*Dp-Unox*	*7.262*	*14.4*	*24.0*	*185.2*	*161.2*	Non acid-generating	NAG	NAG
BP44	*Jd*	*7.17*	*44.8*	*27.7*	*200.2*	*172.5*	Non acid-generating	NAG	NAG
BP48	*Jd*	*7.34*	*81.6*	*48.8*	*235.2*	*186.5*	Non acid-generating	NAG	NAG
BP63	*CZR*	*7.01*	*74.6*	*67.5*	*320.3*	*252.8*	Non acid-generating	NAG	NAG
BP97	*Dp-Unox*	*6.244*	*341.6*	*54.4*	*335.3*	*280.9*	Non acid-generating	NAG	NAG
BP35	*Jd*	*6.734*	*327.6*	*119.4*	*25.0*	*-94.4*	Potentially acid generating	PAG	Uncertain (PAG)
BP96	*Dp-Unox*	*6.85*	*49.8*	*90.0*	*5.0*	*-85.0*	Potentially acid generating	PAG	Uncertain (PAG)
BP66	*Dp-Unox*	*6.128*	*327*	*107.8*	*40.0*	*-67.8*	Potentially acid generating	PAG	Uncertain (PAG)
BP6	*Jd*	*6.758*	*103.6*	*81.3*	*40.0*	*-41.3*	Potentially acid generating	PAG	Uncertain (PAG)
BP68	*Dp-Unox*	*6.352*	*373*	*72.8*	*35.0*	*-37.8*	Potentially acid generating	PAG	Uncertain (PAG)
BP88	*Drc-unox*	*6.60*	*228*	*45.9*	*10.0*	*-35.9*	Potentially acid generating	PAG	Uncertain (PAG)
BP8	*CZR*	*6.666*	*44.8*	*150.9*	*120.1*	*-30.8*	Potentially acid generating	PAG	Uncertain (PAG)
BP33	*Jd*	*6.966*	*273.2*	*85.6*	*60.0*	*-25.6*	Potentially acid generating	PAG	Uncertain (PAG)
BP69	*Jd*	*6.402*	*132.8*	*53.4*	*30.0*	*-23.4*	Potentially acid generating	PAG	Uncertain (PAG)

Table 3.3-6 BGMI Humidity Cell Test Summary with BGMI and BLM Waste Rock Classifications

Humidity Cell	Lithology	pH (SU)	Sulfate (mg/L)	AGP (T/Kt)	ANP (T/Kt)	NNP T/Kt)	BGMI Acid Risk Class	BGMI Waste Rock Class	BLM Waste Rock Class
BP78	*Drc-unox*	*5.174*	*148*	*42.5*	*25.0*	*-17.5*	Potentially acid generating	PAG	Uncertain
BP46	*CZR*	*6.922*	*194*	*65.9*	*50.0*	*-15.9*	Potentially acid generating	PAG	Uncertain
BP36	*Jd*	*7.144*	*42.2*	*51.9*	*40.0*	*-11.9*	Potentially acid generating	PAG	Uncertain
BP12	*Jd*	*5.894*	*36*	*4.3*	*20.0*	*15.8*	Potentially acid generating	NAG	Uncertain
BP83	*Ov*	*5.36*	*93.6*	*31.6*	*60.0*	*28.4*	Potentially acid generating	NAG	NAG
BP99	*Dp-Unox*	*5.932*	*35.2*	*13.2*	*50.0*	*36.8*	Potentially acid generating	NAG	NAG
BP59	*Jd*	*7.082*	*38*	*105.3*	*150.1*	*44.8*	Potentially acid generating	NAG	NAG
BP10	*Jd*	*7.132*	*32.2*	*51.3*	*120.1*	*68.9*	Potentially acid generating	NAG	NAG
BP4	*Jd*	*5.958*	*33.4*	*47.8*	*270.2*	*222.4*	Potentially acid generating	NAG	NAG
BP90	*Dp-Unox*	*4.974*	*439.6*	*81.9*	*35.0*	*-46.9*	Strongly acid generating	PAG	Uncertain (PA(
BP57	*CZR*	*4.26*	*43.4*	*37.5*	*5.0*	*-32.5*	Strongly acid generating	PAG	Uncertain (PA(
BP85	*CZR*	*4.834*	*22.2*	*18.8*		*-18.8*	Strongly acid generating	PAG	Uncertain
BP95	*Drc-unox*	*4.62*	*58.8*	*29.2*	*20.0*	*-9.2*	Strongly acid generating	PAG	Uncertain
BP92	*Drc-ox*	*4.274*	*212.2*	*18.9*	*15.0*	*-3.9*	Strongly acid generating	PAG	Uncertain
BP93	*Drc-ox*	*4.45*	*152.2*	*37.8*	*85.0*	*47.2*	Strongly acid generating	NAG	NAG
BP93	Drc-ox	4.45	152.2	43.1	95.1	52.0	Strongly acid generating	NAG	NAG

Notes: BGMI Lithologic Classifications: ARG = Argillaceous; GD = Granodiorite; LS = Limestone; CZR = Contact Zone Rocks; Drc-ox = Oxidized Rodeo Creek Fm; Drc-unox = Unoxidized Rodeo Creek Fm; Dp-ox = Oxidized Popovich; Dp-Unox = Unoxidized Popovich; Ov = Vinini Fm; Jd = Jurassic intrusive.
BGMI Acid Risk Classification Scheme (Based on Humidity Cell test results last 5 weeks): NAG: pH>5.0; sulfate < 20 mg/kg; Potentially Acid Generating: pH>5.0; sulfate > 20 mg/kg. Acid Generating: pH>5.0; sulfate > 20 mg/kg; NNP < -5.0 Strongly Acid Generating: pH< 5.0.
Units Sulfate: mg/L; ANP, AGP, and NNP: t/Kt $CaCO_3$; SU = Standard Units
Blank cell indicates no data.

Source: Schafer 2008b.

BGMI has a two-phase approach for classifying the potential for acid generation in rocks mined at Goldstrike. The first phase is the classification of the rocks from the static ABA test results, which has been discussed at length in the preceding paragraphs. The second phase is the kinetic testing. All rock types mined are subjected to kinetic tests, regardless of whether they are classified as PAG or NAG, as shown in **Table 3.3-6**. The kinetic test results are then used as the basis for the final classification of the potential for acid generation by the rock type.

This second phase of the BGMI method conforms to BLM guidelines (BLM 1996) and allows BGMI to accurately assess the acid generation potential of all waste rock and place waste rock in waste rock facilities such as the Bazza Waste Rock Facility and the proposed Clydesdale Waste Rock Facility in a manner that would prevent the generation of acid seepage from the waste rock facilities. Because BGMI conducts kinetic tests on all rock types mined as part of its two-phase approach, the BGMI method is more conservative than the BLM guidelines and allows for the management of waste rock in a manner that would prevent acidic seepage. Also, field observations and monitoring of the existing waste rock facilities at the Goldstrike Mine over the past 15 years have shown no evidence of acid rock seepage. These data show that BGMI's two-phase method of waste rock classification and its management of PAG waste rock in waste rock facilities is working and prevents the generation of acid rock drainage (ARD).

Geochemistry of the Proposed Expansion Area and Characteristics of Rocks Routed to the Clydesdale Waste Rock Facility

The proposed pit expansion consists of two laybacks containing approximately 315 million tons of waste rock. Over 28,000 lithologic logs were taken for sampled intervals in boreholes drilled in the 2NW and 3NW laybacks. Additionally, 2,368 static ABA tests were conducted on selected samples, mostly within the ore-bearing zones in the Popovich Formation. A small portion of the Popovich samples were PAG, while the majority of the clastic Rodeo Creek samples were PAG (Schafer 2008b).

Rodeo Creek and Vinini rock units comprise the majority of waste rock in the laybacks. Approximately 19 percent of the mined rock in the proposed laybacks is expected to be PAG, which is similar to the historic amount of PAG material for the life of the mine (Schafer 2008b).

The proposed Clydesdale Waste Rock Facility would receive up to 350 million tons of waste rock from the proposed laybacks and from other permitted portions of the mine. Overall, about 10 percent of the rock to be mined from all sources (current authorized mining and the proposed laybacks) from early 2007 through 2015 is classified as PAG. Historically, approximately 25 percent of the mined rock at the Goldstrike Mine has been PAG. The majority of PAG material would be placed as pit backfill; consequently, PAG rock would constitute approximately 7 percent of the tonnage placed collectively in the Bazza and Clydesdale Waste Rock facilities (Schafer 2008b).

3.3.2 Environmental Consequences

The primary issues related to groundwater resources include:

- Reduction in groundwater quantity from mine dewatering through 2015 under existing permits and authorizations from the State of Nevada (No Action Alternative);
- Impacts to groundwater quality from the construction, operation, and closure of mine facilities; and
- Impacts related to the water quality of the post-mining pit lake.

Groundwater modeling for estimation of environmental consequences was conducted with an updated version of the groundwater model used in BLM (2000a). The minor changes to this model are discussed in **Appendix B**, Groundwater Resources and Geochemistry.

3.3.2.1 No Action Alternative

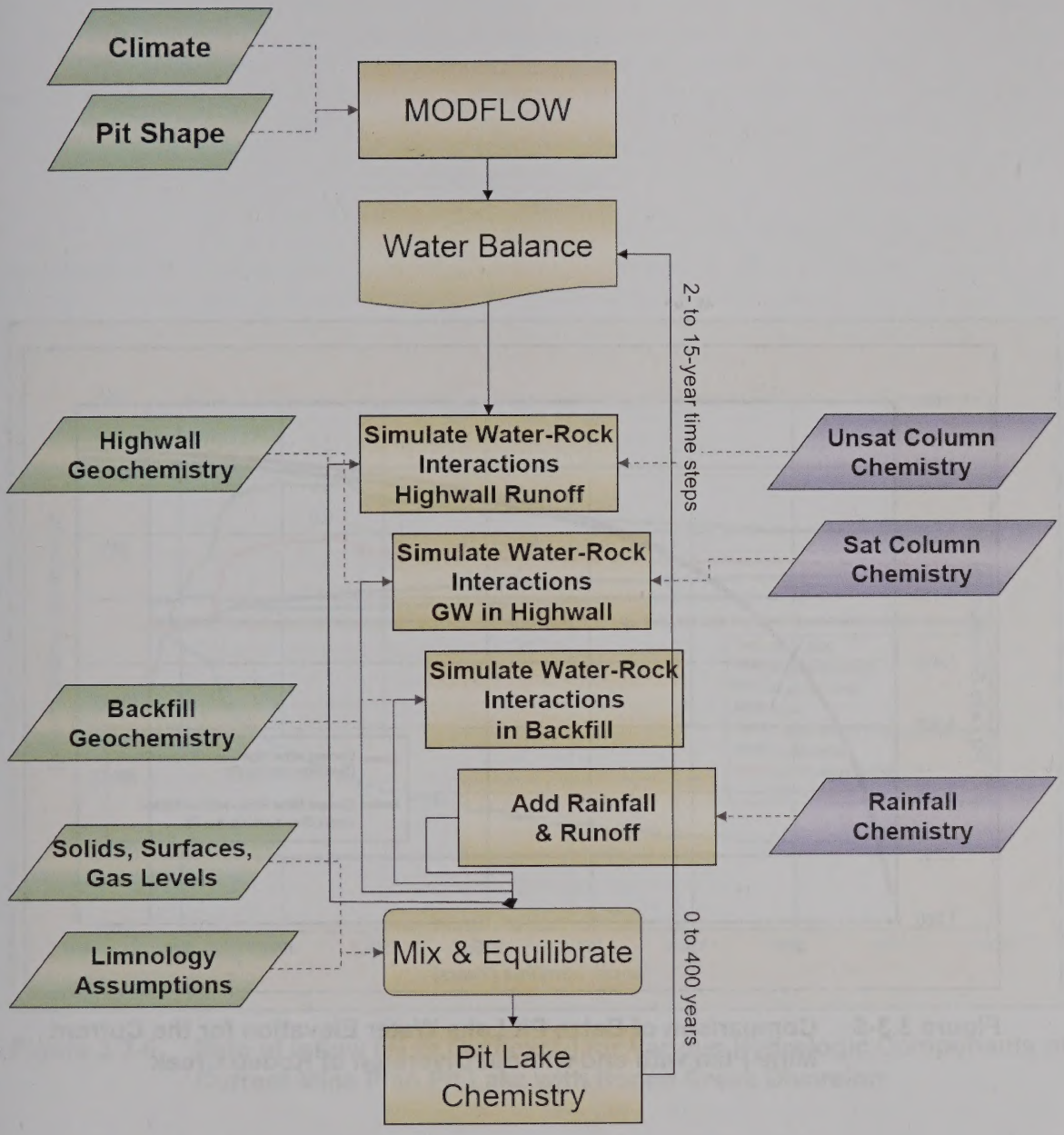
Under the No Action Alternative, the Betze Pit would not be expanded beyond current authorizations. Groundwater pumping and dewatering of the pit prior to cessation of mining would continue as discussed in the Betze Project SEIS (BLM 2000a, 2003a) and in Chapter 2.0; dewatering would continue for an additional 4 years beyond 2011, as analyzed in the Betze Project SEIS (BLM 2000a, 2003a).

Post-mining Pit Lake

The chemistry of the post-mining pit lake would be controlled by the composition of the various types of water flowing into the pit and the reaction of these waters with the pit highwall rocks and the waste rock left in the pit. Groundwater flowing into the pit through the highwalls and the pit floor would come mostly from carbonate rock and from the Carlin Formation along the east highwall. Rain would fall into the pit directly and also would produce pit wall runoff. It was estimated that approximately 14.9 percent of rainfall would enter the pit as pit wall runoff (Schafer 2007). The composition of the principal waters expected to contribute to the post-mining pit are given in **Table B-7**, in **Appendix B**. These waters would react with rocks in the pit highwalls and the waste rock left in the pit after mining to produce the final pit lake water quality. **Figure 3.3-4** shows the sequence of reactions used in modeling the pit lake water quality over time. Groundwater inflow to the pit was modeled using the BGMI Groundwater Flow Model (McDonald Morrissey Associates 1998); chemical reactions were modeled with the USGS chemical reaction modeling code PHREEQC (Parkhurst and Appelo 1999). The details of the pit lake water quality modeling can be found in Schafer (2007) and are summarized in this section.

Figure 3.3-5 shows the cumulative water elevation of the post-mining pit lake over time; **Figure 3.3-6** shows the proportions of different water types over time as the pit lake forms. The pit lake would be a terminal pit lake, meaning that groundwater and surface water would flow into the pit, and no groundwater would flow out of the pit. Evaporation from the enlarging pit lake would eventually balance the water flowing into the pit at steady state, which would occur approximately 400 years after cessation of pumping (**Figure 3.3-6**). In the Betze Project Draft SEIS (BLM 2000a), the pit lake was modeled out to 230 years, which is approximately 95 percent of full recovery. Modeling out to 400 years more closely approaches the final steady state water level in the pit lake and allows chemical trends in the pit lake water quality that will be influenced by evaporation to be more evident. During the first 14 years of pit lake formation, runoff from the pit highwalls would constitute the main source of inflow to the pit (Schafer 2007). The groundwater level would be below the pit bottom, so water flowing into the pit would evaporate and infiltrate to some degree. Groundwater inflow through the pit highwalls and pit bottom would begin around Year 14 and would be expected to be the dominant form of inflow by Year 20. As shown in **Figure 3.3-6**, there is a major change in the percentage contribution of inflowing water types starting around Year 20. By Year 50, the percentage contribution of inflowing water types would have stabilized with groundwater flow through the pit highwalls becoming the dominant contribution to the pit lake. This pattern of water inflow to the pit lake would continue to a near steady state condition at Year 400 with evaporation becoming important after about Year 50 due to the enlarging pit lake. This change in inflowing water contributions is reflected in a change in pit lake water quality.

Rodeo Creek may be diverted into the post-mining pit as an option at mine closure. BGMI is not seeking approval for the diversion of Rodeo Creek from the Nevada State Engineer and the NDEP at this time. The BLM has no decision-making authority relative to the diversion of Rodeo Creek. The expected average flow rate of Rodeo Creek into the pit would be approximately 225 gpm (Schafer 2007). The Rodeo Creek water quality used in the pit lake water quality modeling is given in **Table B-7**. The diversion of Rodeo Creek into the Betze Pit upon completion of mining would be a permanent diversion and would not substantially affect the overall water balance for the pit lake once the pit lake reaches steady state. The final pit lake elevation under the No Action Alternative at steady state (Year 400) would be an estimated 5,144 feet amsl. The Betze Pit Lake associated with the No Action Alternative is approximately 803 acres. Approvals and modifications not requiring NEPA action have modified the No Action Betze Pit Lake surface area acreage in the interim since the 2000 SEIS.



Betze Pit Expansion Project

Figure 3.3-4

Structure of Betze Pit Lake Model

Source: Schafer 2007.

4/23/08

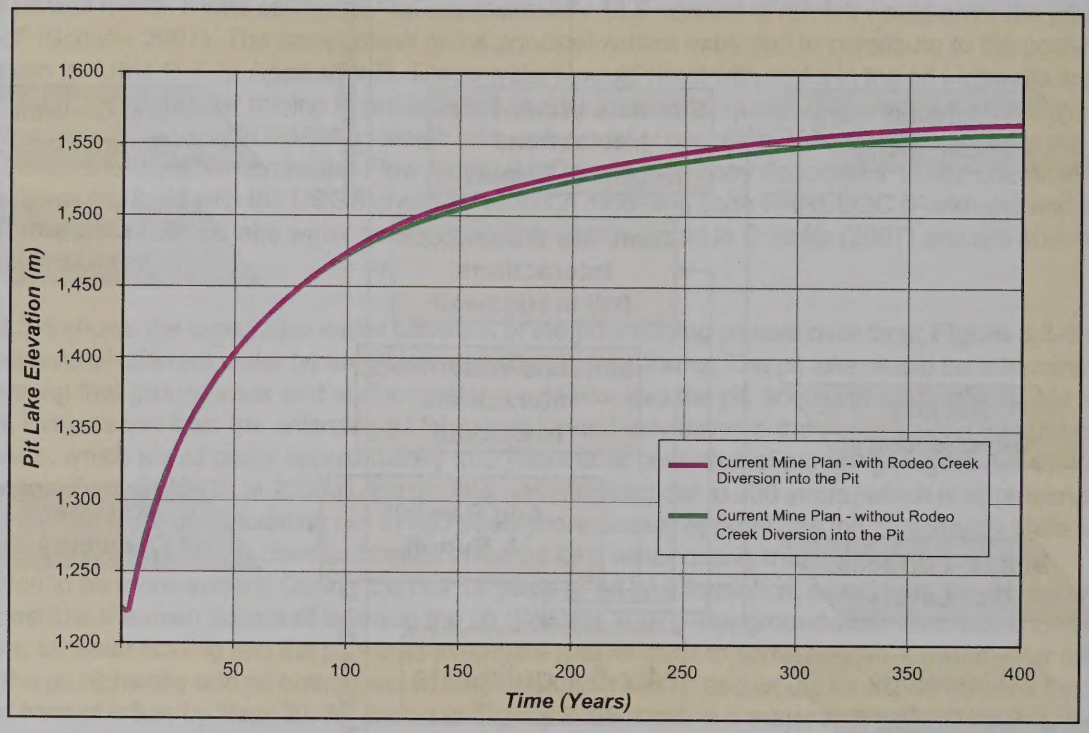


Figure 3.3-5 Comparison of Betze Pit Lake Water Elevation for the Current Mine Plan with and without Diversion of Rodeo Creek

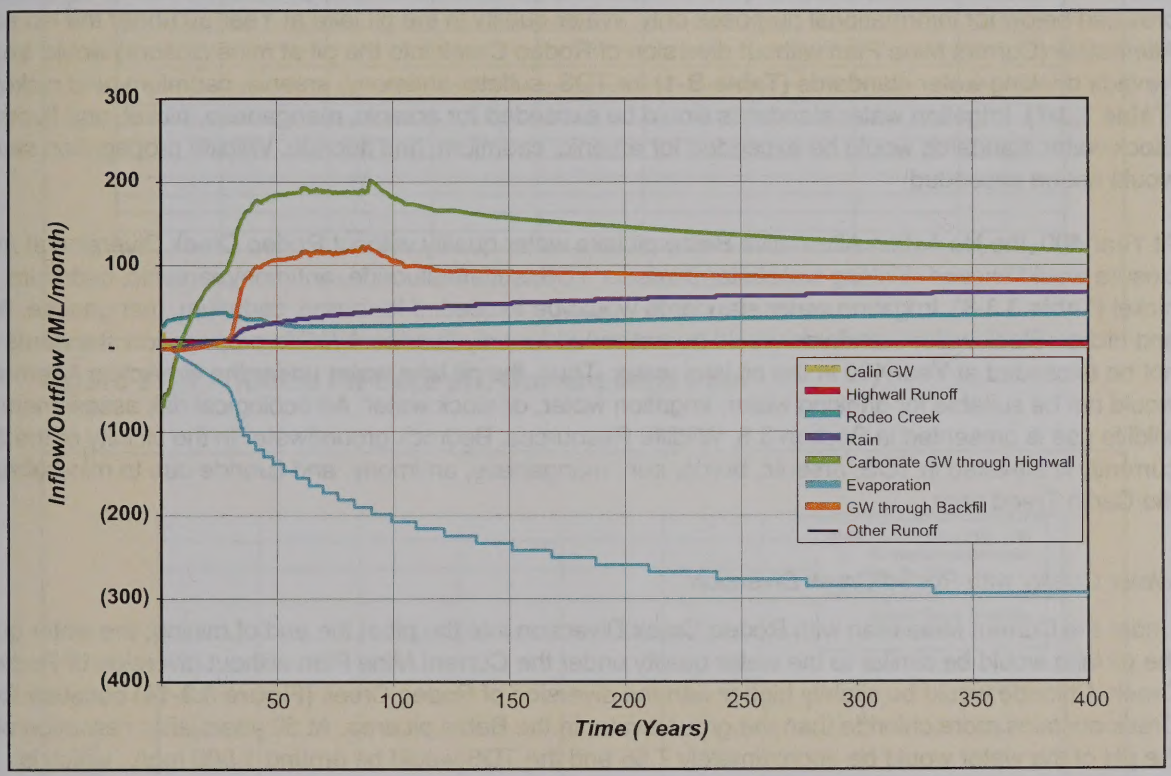


Figure 3.3-6 Rate of Inflow (+) or Outflow (-) for Various Hydrologic Components of Current Mine Plan Pit Lake with Rodeo Creek Diversion

Chemical changes in the pit lake with time under the Current Mine Plan are shown in **Figures 3.3-7** through **3.3-25.** These figures compare the predicted water quality in the pit lake with time under two potential mine closure options: 1) diversion of Rodeo Creek into the pit at the end of mining, and 2) no diversion of Rodeo Creek into the pit at the end of mining. These chemical changes reflect the differing proportions of water types entering the pit lake at various times, the reaction between inflowing waters and the pit walls and waste rock left in the pit, and chemical reactions within the pit water leading to precipitation of some minerals, most notably ferrihydrite (iron oxyhydroxide), and the sorption of metals, such as arsenic, on the precipitating phases.

Water Quality Without Rodeo Creek Diversion

Pit lake water is not intended for use as drinking water or agricultural water, nor has it been designated by NDEP for such uses. Comparison of predicted pit lake water to water quality standards based on use is provided below for informational purposes only. Water quality in the pit lake at Year 50 under the No Action Alternative (Current Mine Plan without diversion of Rodeo Creek into the pit at mine closure) would exceed Nevada drinking water standards (**Table B-1**) for TDS, sulfate, antimony, arsenic, cadmium, and nickel (**Table 3.3-7**). Irrigation water standards would be exceeded for arsenic, manganese, nickel, and fluoride. Stock water standards would be exceeded for arsenic, cadmium, and fluoride. Wildlife propagation standards would not be exceeded.

At Year 400, the No Action Alternative Betze pit lake water quality without Rodeo Creek Diversion at mine closure would exceed drinking water standards for TDS, sulfate, fluoride, antimony, arsenic, cadmium, and nickel (**Table 3.3-8**). Irrigation water standards would be exceeded for boron, cadmium, manganese, fluoride, and nickel. Stock water standards would be exceeded for only fluoride. Wildlife propagation standards would not be exceeded at Year 400 in the pit lake water. Thus, the pit lake water under the No Action Alternative would not be suitable for drinking water, irrigation water, or stock water. An ecological risk assessment for wildlife use is presented in Section 3.8, Wildlife Resources. Bedrock groundwater in the vicinity of the Betze Pit currently is elevated in TDS, arsenic, boron, iron, manganese, antimony, and fluoride due to mineralization in the Carlin Trend area.

Water Quality with Rodeo Creek Diversion

Under the Current Mine Plan with Rodeo Creek Diversion into the pit at the end of mining, the water quality in the pit lake would be similar to the water quality under the Current Mine Plan without diversion of Rodeo Creek. Chloride would be slightly higher with the diversion of Rodeo Creek (**Figure 3.3-14**) because Rodeo Creek contains more chloride than the groundwater in the Betze pit area. At 50 years after cessation of mining, the pH of the water would be approximately 7.56 and the TDS would be around 1,800 mg/L, which is somewhat less than the TDS of 2,000 mg/L under the Current Mine Plan without the Rodeo Creek Diversion (**Figure 3.3-7**). Sulfate would be about 999 mg/L compared to 1,230 mg/L without Rodeo Creek (**Table 3.3-7**). The pit lake would exceed drinking water, stock water, and irrigation water standards for arsenic (0.276 mg/L), drinking water standards for antimony (0.019 mg/L), stock water standards for boron (0.7 mg/L), drinking water and irrigation water standards for nickel (1.58 mg/L),and drinking water, stock water and irrigation water standards for cadmium (0.054 mg/L). Manganese (1.65 mg/L) and fluoride (2.0 mg/L) would exceed irrigation water standards (**Table B-1**). Drinking water standards would be exceeded for sulfate and TDS. The pit lake water would be a calcium-sodium sulfate dominated water. The pit lake water is not intended for drinking water use.

At Year 400, which is approximately steady state for the pit lake water level, the pit lake water quality with Rodeo Creek Diversion would have a pH of about 7.72 and a TDS of approximately 2,000 mg/L, similar to the water quality without the Rodeo Creek Diversion. Boron (2.7 mg/L) would exceed irrigation water standards, fluoride (4.7 mg/L) would exceed drinking water, stock water, and irrigation water standards, cadmium (0.034 mg/L) would exceed irrigation water standards, and nickel (1.12 mg/L) would exceed drinking water and

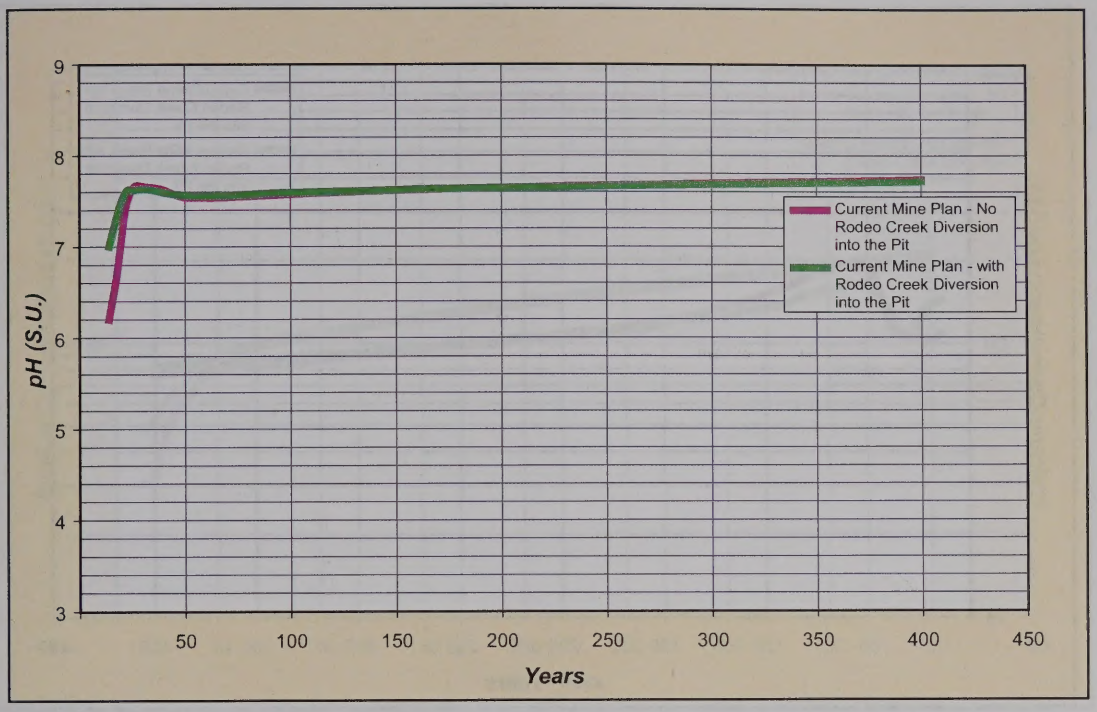


Figure 3.3-7 Betze Pit Lake pH, Current Mine Plan

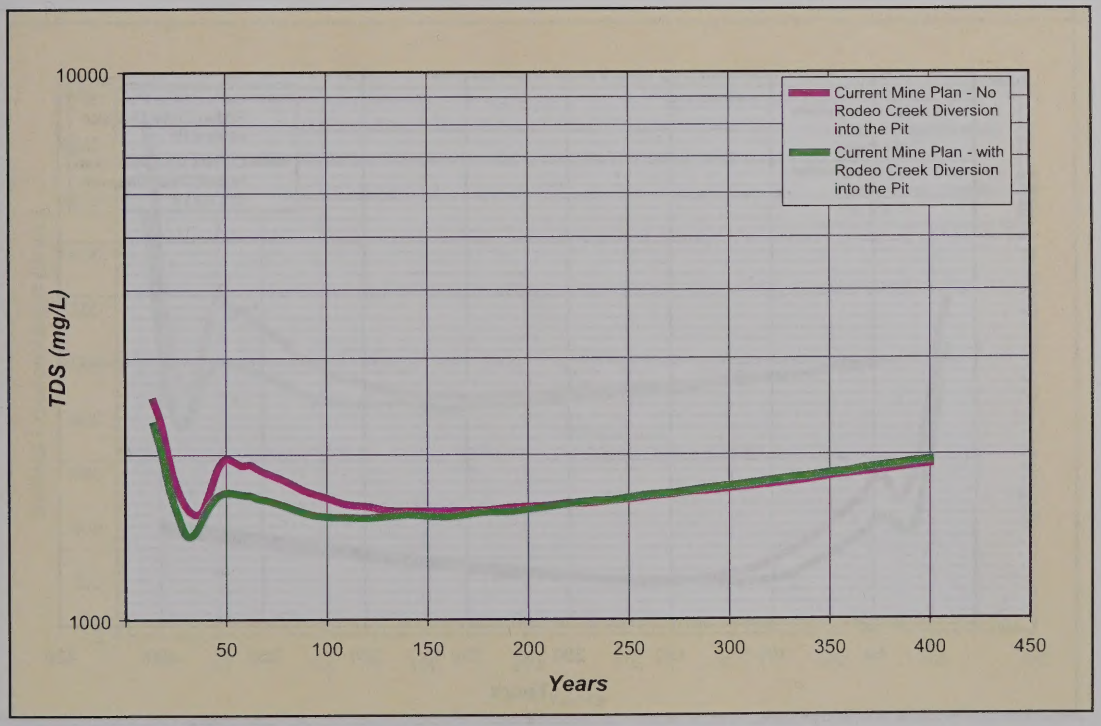


Figure 3.3-8 Betze Pit Lake Total Dissolved Solids, Current Mine Plan

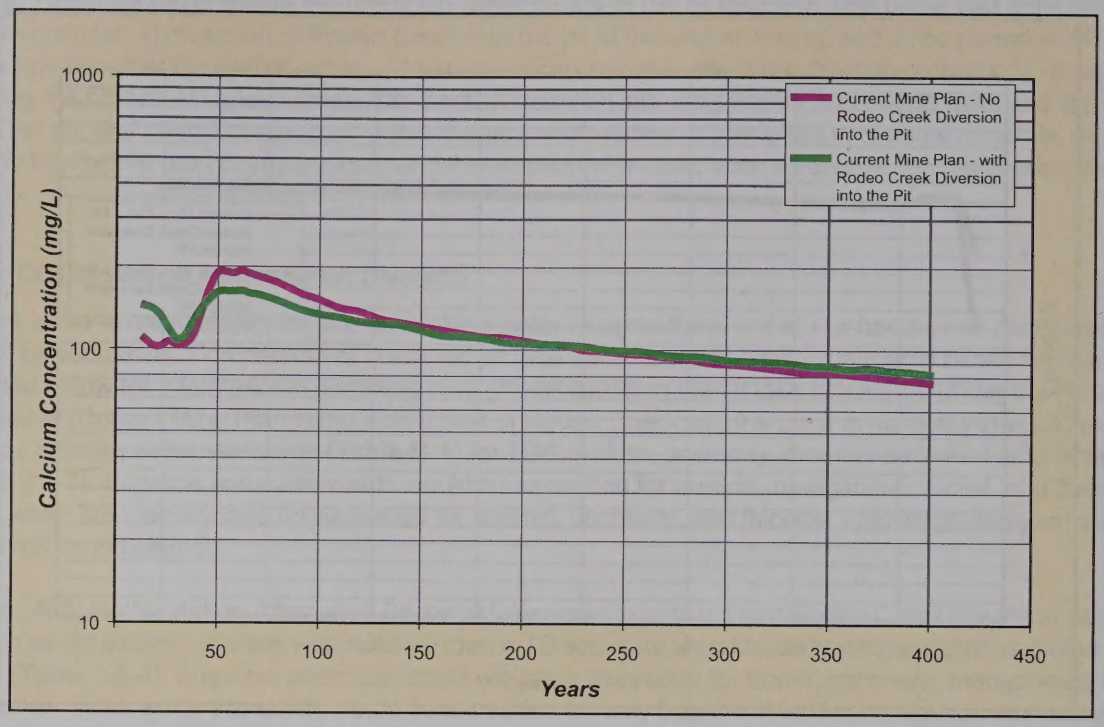


Figure 3.3-9 Betze Pit Lake Calcium Chemistry, Current Mine Plan

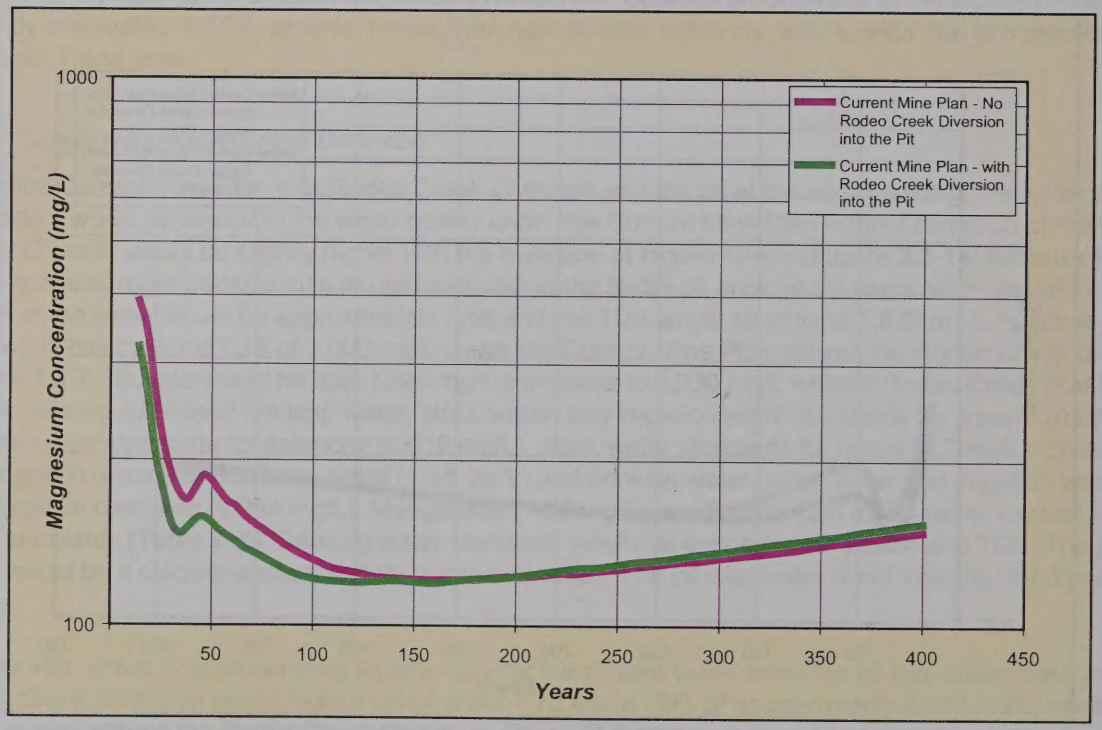


Figure 3.3-10 Betze Pit Lake Magnesium Chemistry, Current Mine Plan

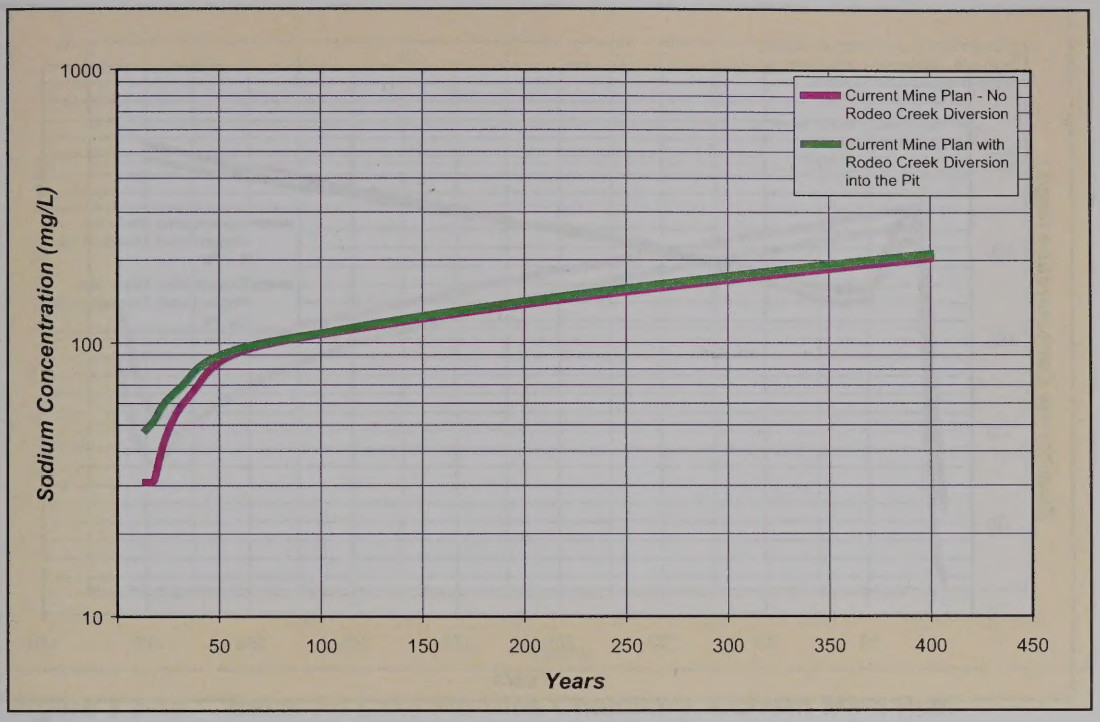


Figure 3.3-11 Betze Pit Lake Sodium Chemistry, Current Mine Plan

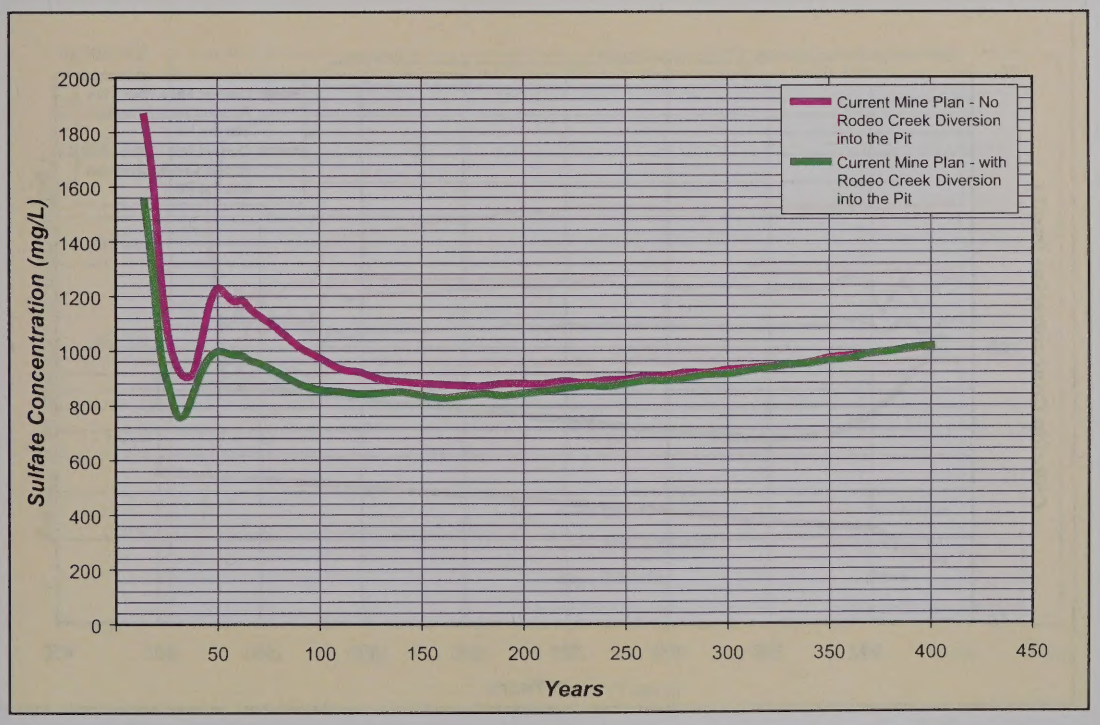


Figure 3.3-12 Betze Pit Lake Sulfate Chemistry, Current Mine Plan

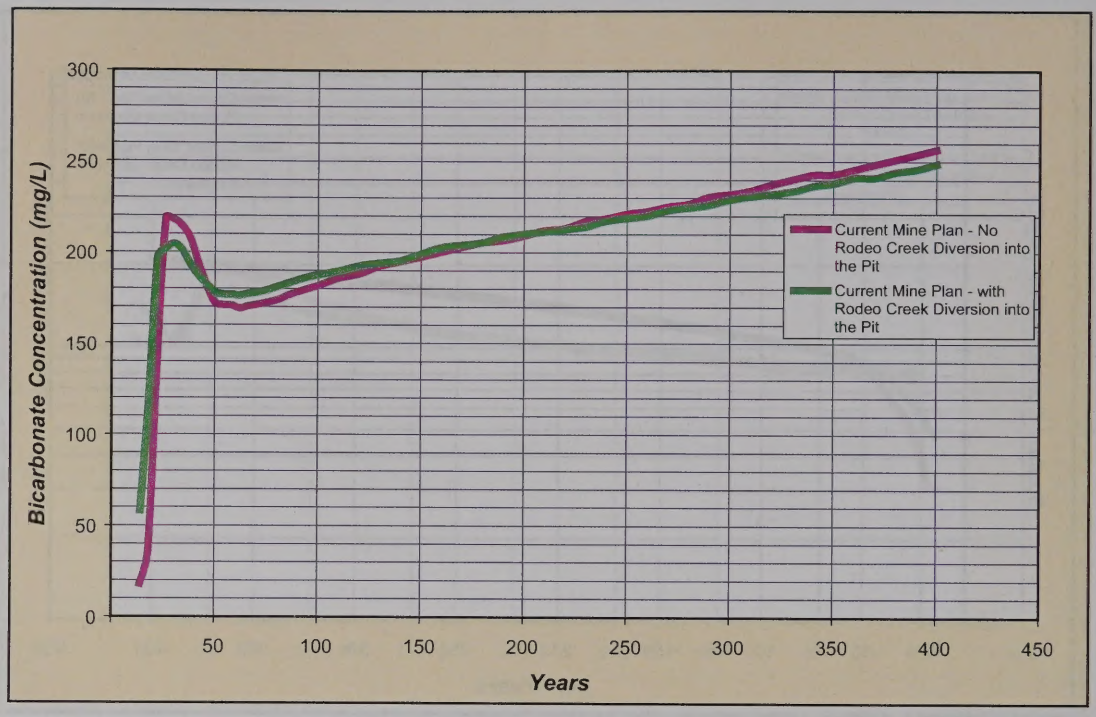


Figure 3.3-13 Betze Pit Lake Bicarbonate Chemistry, Current Mine Plan

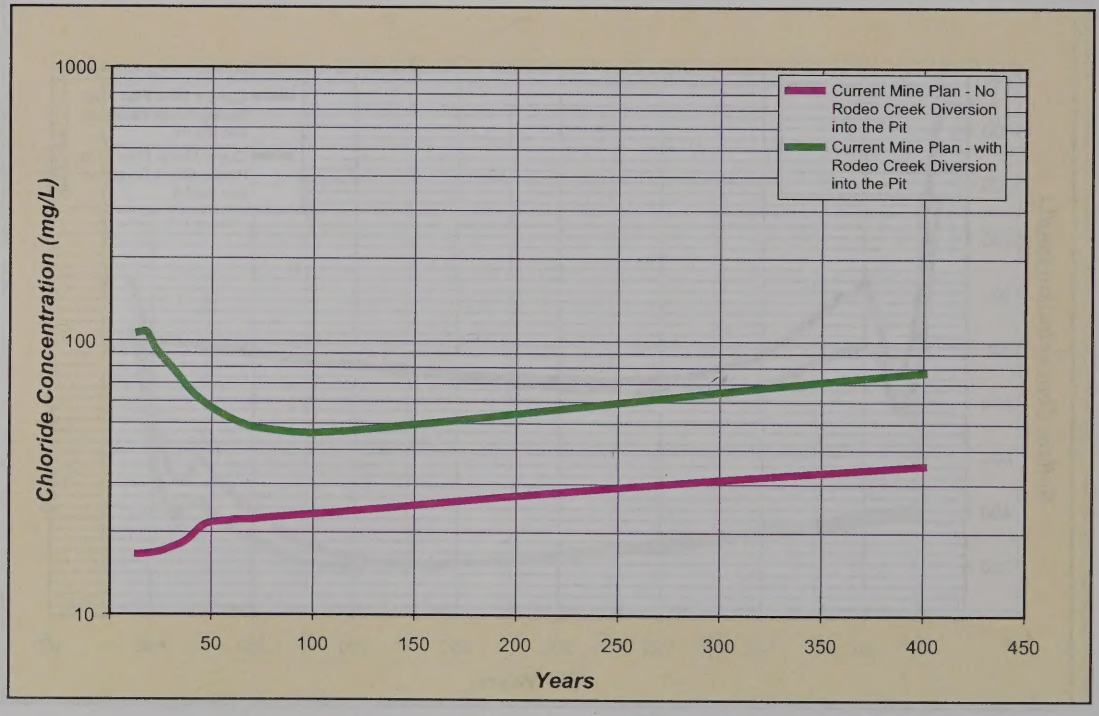


Figure 3.3-14 Betze Pit Lake Chloride Chemistry, Current Mine Plan

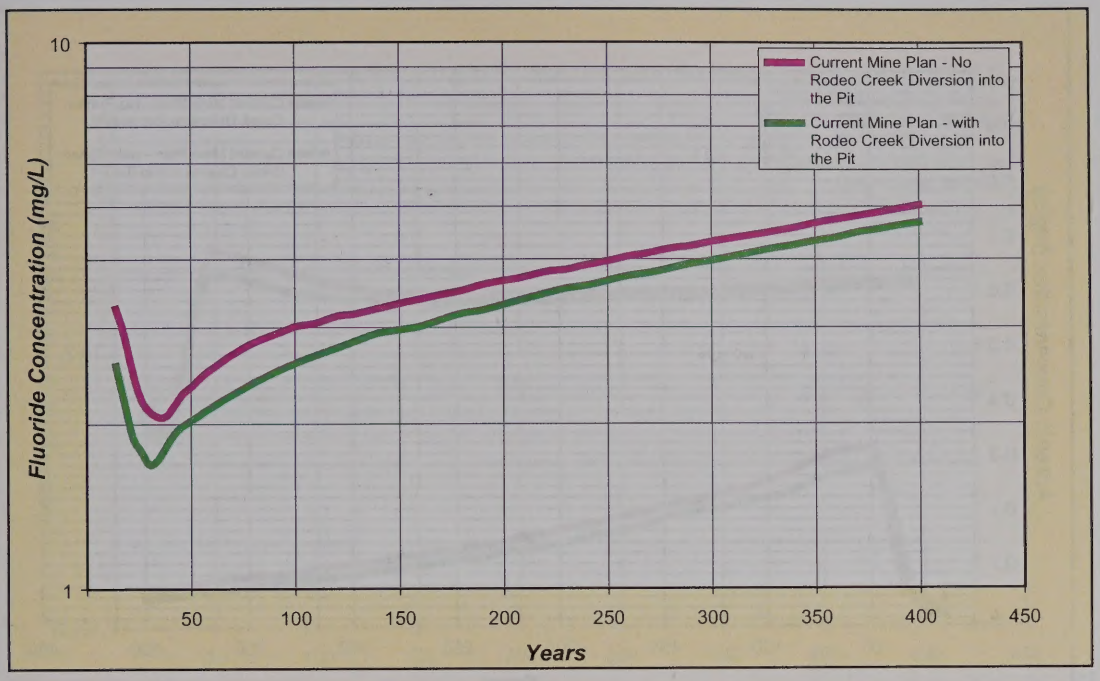


Figure 3.3-15 Betze Pit Lake Fluoride Chemistry, Current Mine Plan

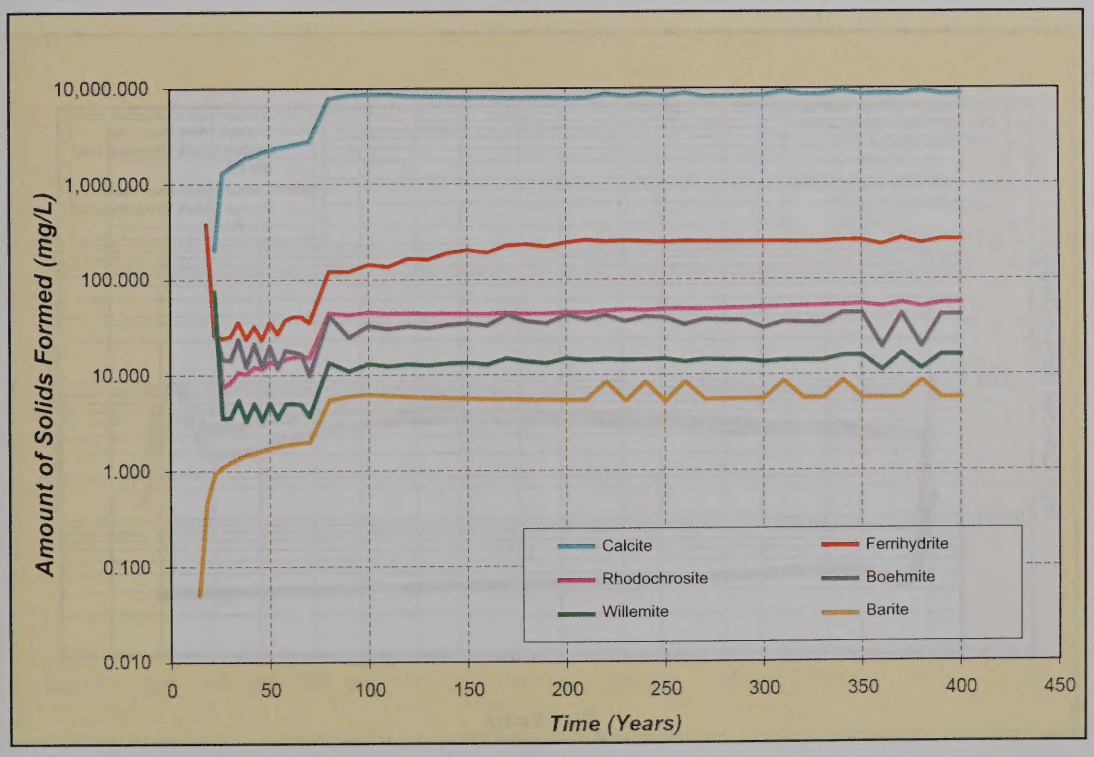


Figure 3.3-16 Predicted Quantity of Mineral Solids for Expanded Pit and Currrent Mine Plan

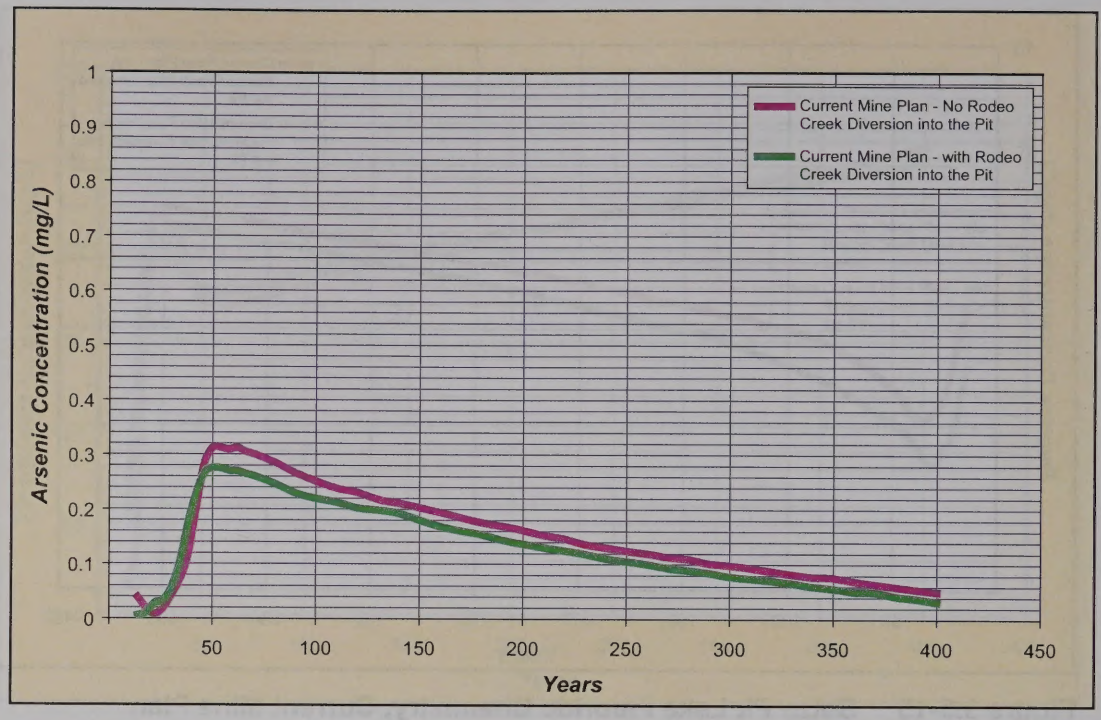


Figure 3.3-17 Betze Pit Lake Arsenic Chemistry, Current Mine Plan

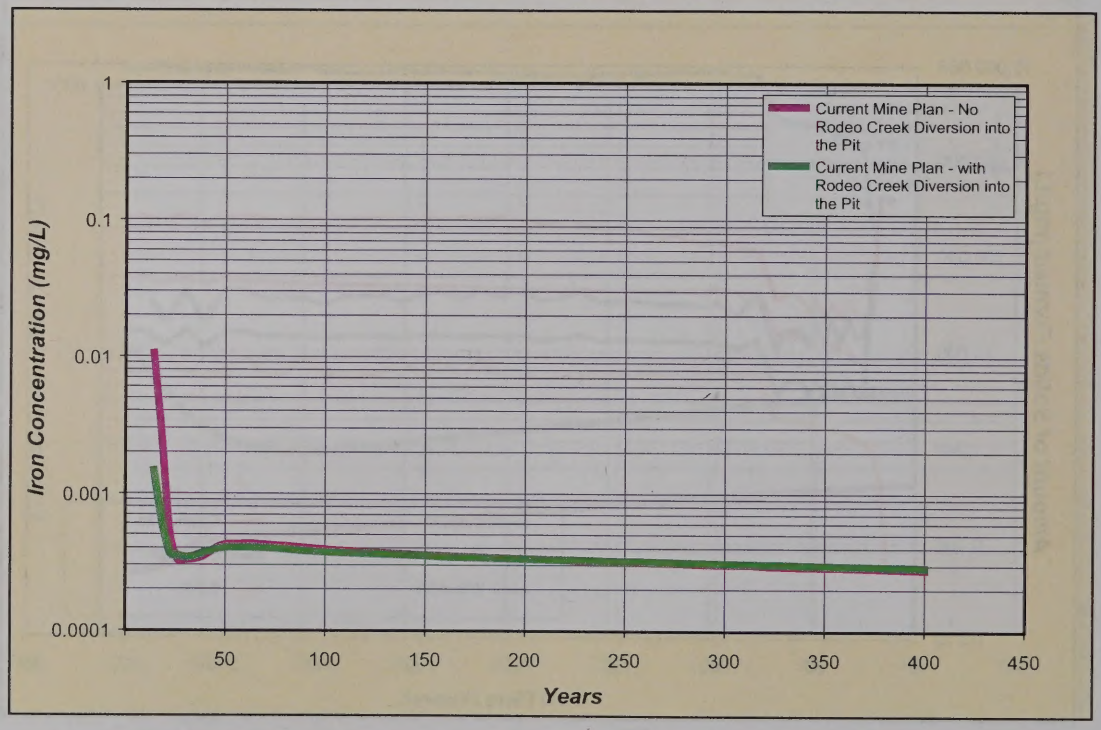


Figure 3.3-18 Betze Pit Lake Iron Chemistry, Current Mine Plan

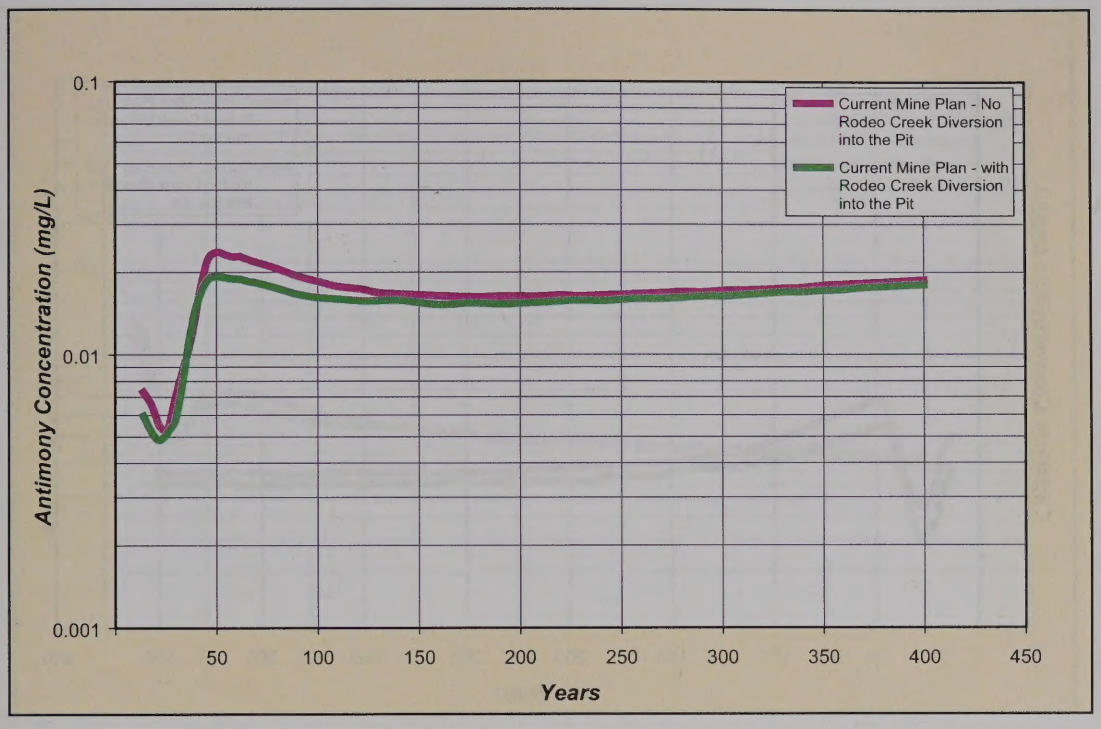


Figure 3.3-19 Betze Pit Lake Antimony Chemistry, Current Mine Plan

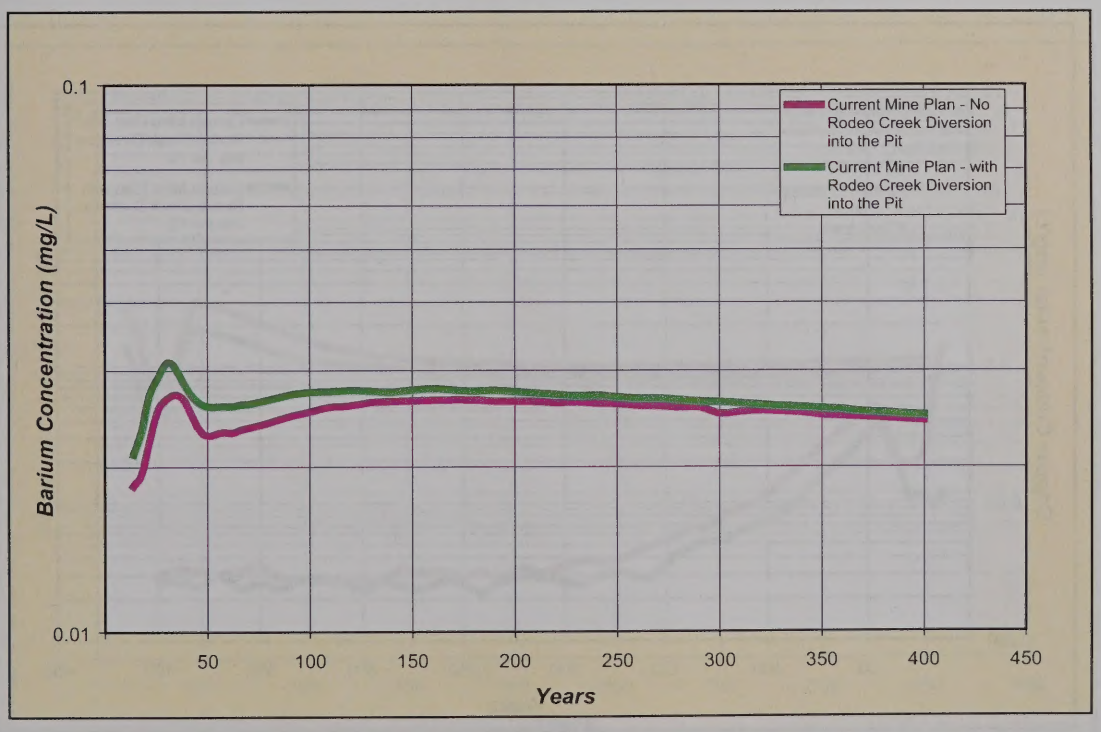


Figure 3.3-20 Betze Pit Lake Barium Chemistry, Current Mine Plan

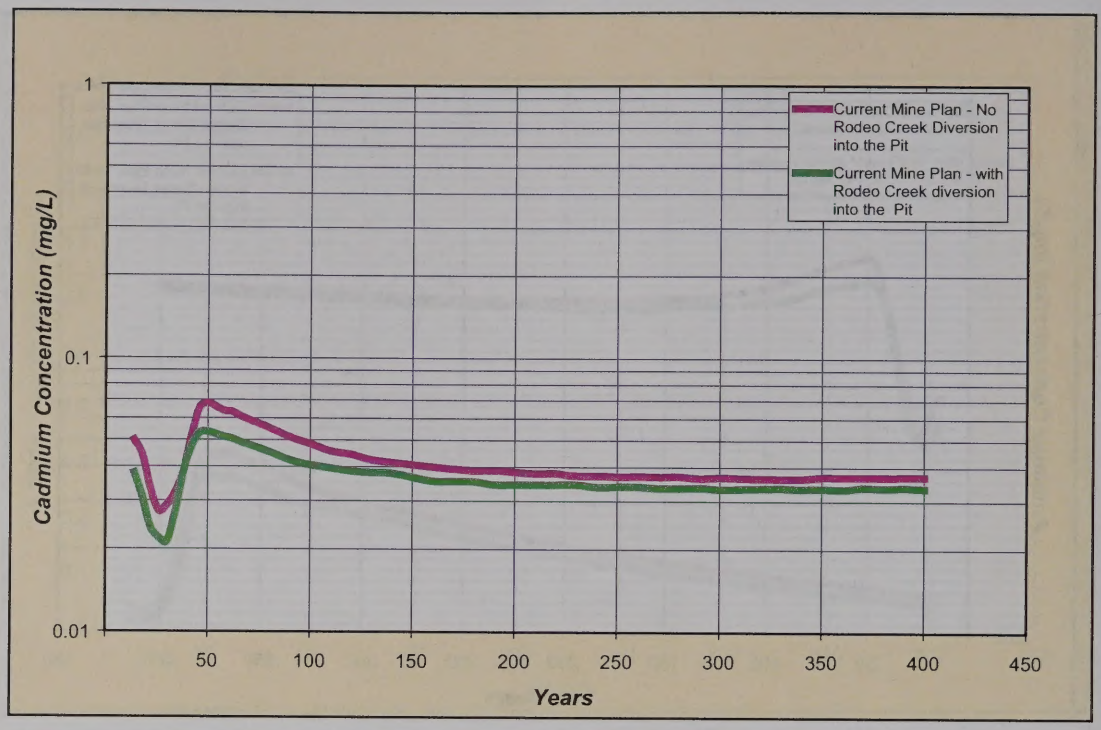


Figure 3.3-21 Betze Pit Lake Cadmium Chemistry, Current Mine Plan

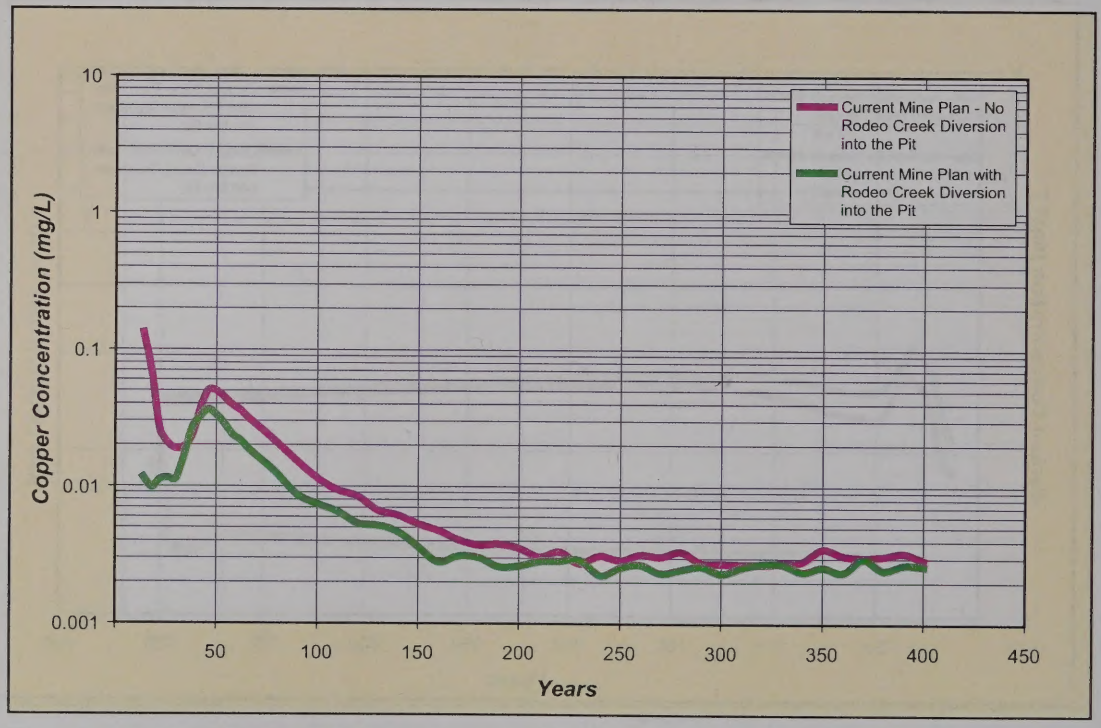


Figure 3.3-22 Betze Pit Lake Copper Chemistry, Current Mine Plan

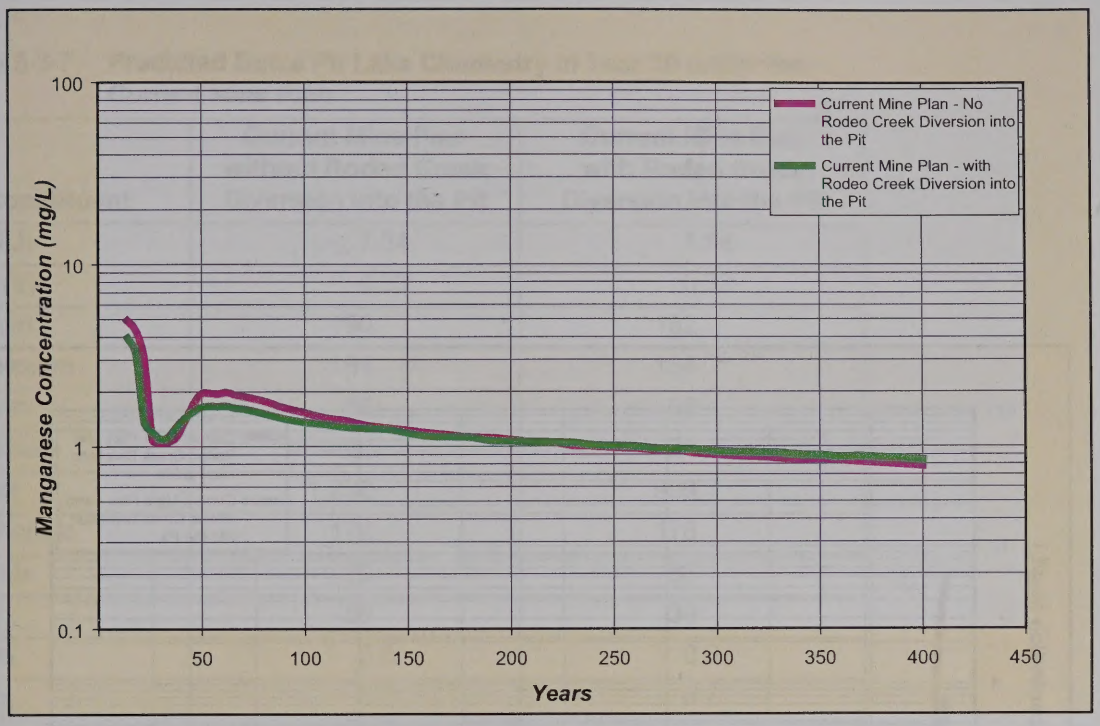


Figure 3.3-23 Betze Pit Lake Manganese Chemistry, Current Mine Plan

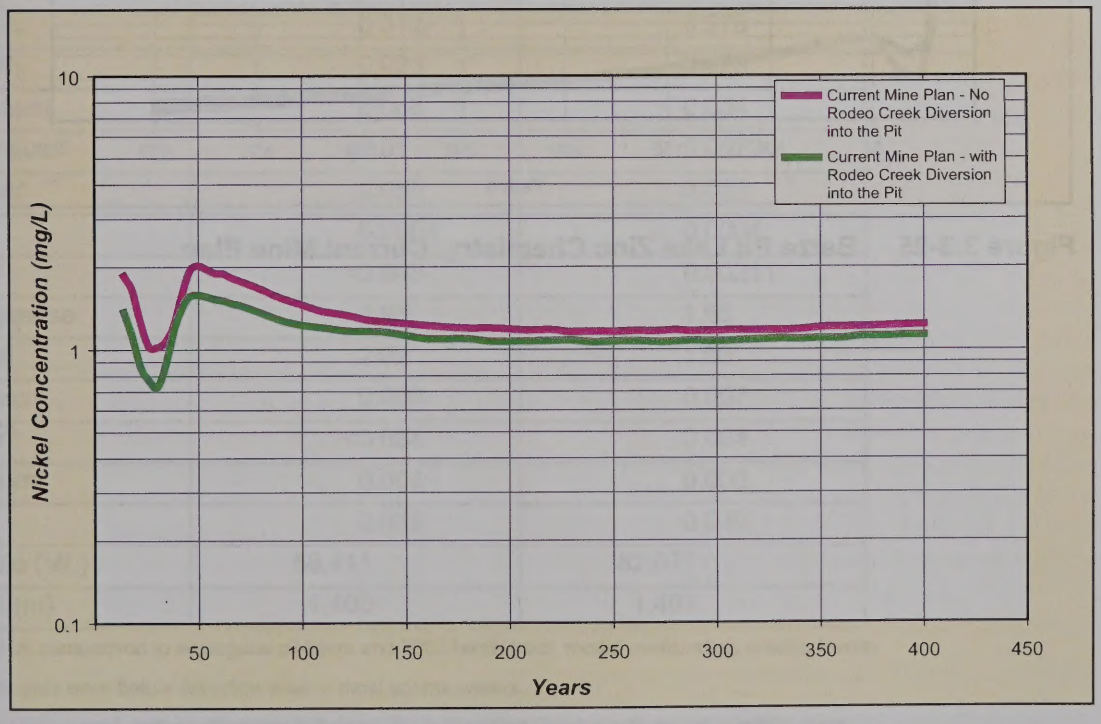


Figure 3.3-24 Betze Pit Lake Nickel Chemistry, Current Mine Plan

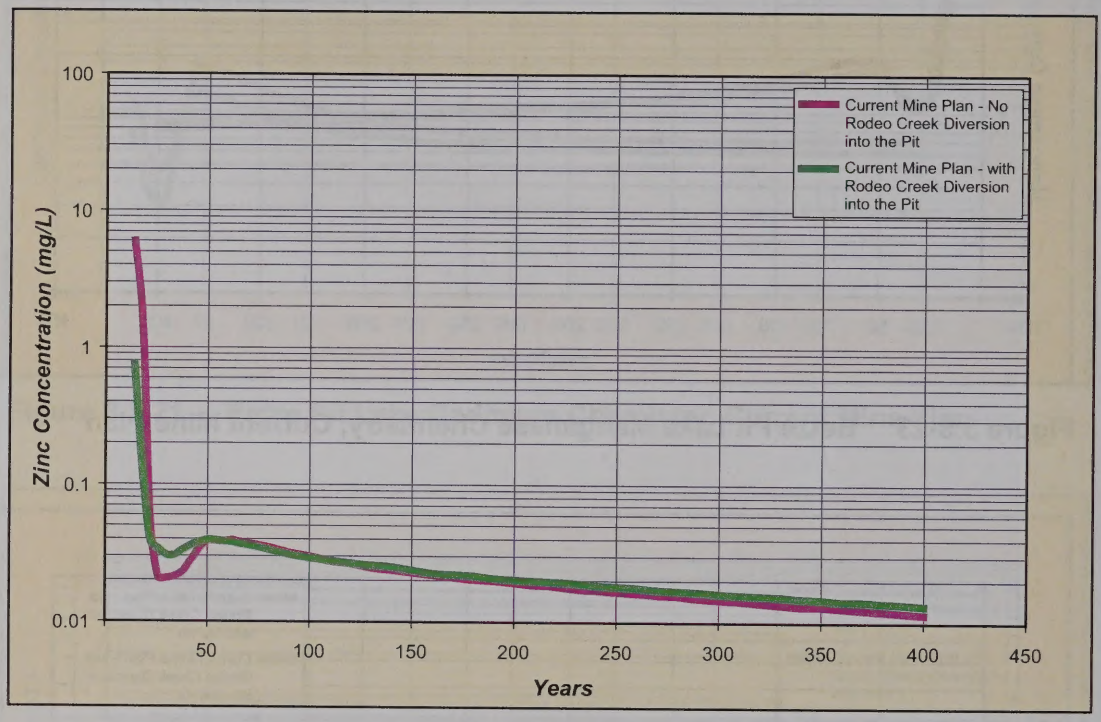


Figure 3.3-25 Betze Pit Lake Zinc Chemistry, Current Mine Plan

Table 3.3-7 Predicted Betze Pit Lake Chemistry in Year 50 under the Current Mine Plan

Constituent	Current Mine Plan without Rodeo Creek Diversion into the Pit	Current Mine Plan with Rodeo Creek Diversion into the Pit
pH (SU)	7.54	7.56
ORP (V)	0.33	0.33
Calcium	190	162
Magnesium	184	154
Sodium	85	90
Potassium	22	21
Sulfate	1,230	999
Bicarbonate	172	178
Chloride	22	57
Silica	55	39
Nitrate	0.5	0.6
Boron	0.7	0.7
Fluoride	2.3	2.0
Aluminum	0.005	0.005
Antimony	0.024	0.019
Arsenic[1]	0.312	0.276
Barium	0.023	0.026
Cadmium	0.068	0.054
Chromium[2]	<0.01	0.0073
Copper	0.050	0.033
Iron	0.0004	0.0004
Lead[2]	<0.003	0.00211
Manganese	1.96	1.65
Nickel	2.02	1.58
Selenium	0.009	0.007
Silver[2]	<0.004	0.004
Thallium	0.006	0.005
Zinc	0.039	0.039
Volume (ML)	58,411	82,077
Stage (m)	1,400	1,407

[1]Based on comparison to analogous pit lakes and 2002 batch tests, model overpredicts arsenic levels.

[2]Constituents were below detection level in most source waters.

Notes: Units = mg/L unless otherwise indicated; SU = Standard Units; V = Volts; ML = million liters; M = meters.

Source: Schafer 2007.

Table 3.3-8 Predicted Betze Pit Lake Chemistry in Year 400 Under the Current Mine Plan

Constituent	Current Mine Plan without Rodeo Creek Diversion into the Pit	Current Mine Plan with Rodeo Creek Diversion into the Pit
pH (SU)	7.73	7.72
ORP (V)	0.32	5.48
Calcium	76	82
Magnesium	149	154
Sodium	204	212
Potassium	57	55
Sulfate	1,017	1,017
Bicarbonate	257	249
Chloride	35	77
Silica	115	98
Nitrate	1.6	1.8
Boron	2.7	2.7
Fluoride	5.0	4.7
Aluminum	0.007	0.007
Antimony	0.019	0.018
Arsenic[1]	0.051	0.032
Barium	0.024	0.025
Cadmium	0.037	0.034
Chromium[2]	<0.00009	0.0001
Copper	0.003	0.003
Iron	0.0003	0.0003
Lead[2]	<0.00008	0.00006
Manganese	0.78	0.84
Nickel	1.23	1.12
Selenium	0.007	0.007
Silver[2]	<0.008	0.008
Thallium	<0.004	0.004
Zinc	0.012	0.013
Volume (ML)	460,830	453,410
Stage (m)	1,560	1,566

[1]Based on comparison to analogous pit lakes and 2002 batch tests, model overpredicts arsenic levels.

[2]Constituents were below detection level in most source waters.

Notes: Units = mg/L unless otherwise indicated; SU = Standard Units; V = Volts; ML = million liters; M = meters.

Source: Schafer 2007.

irrigation water standards. The water would be a sodium-calcium sulfate dominated water. The pit lake water would not be used for drinking water. The pit lake water quality as a function of time for the Current Mine Plan with Rodeo Creek Diversion is shown in **Figures 3.3-7** through **3.3-25.**

Comparison of 2000 and 2007 Groundwater Models

Groundwater levels, and especially estimated groundwater drawdown contours prepared by BGMI for this SEIS, differ slightly from those in the SEIS prepared for the Goldstrike Mine in 2000 (BLM 2000a;2003a) (**Figure 3.3-26**). This is most apparent for the predicted 10-foot maximum drawdown contour. This contour refers to the maximum extent of the 10-foot drawdown and is not specific to any time period. The most notable difference is northwest of the Betze Pit in the area of Rock Creek where the 10-foot maximum drawdown contour from the 2007 model extends about 2 miles farther to the west and northwest than the 10-foot maximum drawdown contour from the 2000 model (BLM 2000a). This results in additional springs being included within the projected 10-foot maximum drawdown contour for 2007 that were not included in the 2000 projection. These springs that fall outside the 2000 projection of the maximum 10-foot drawdown but within the 2007 projection of that same contour are located within the 2000 maximum cumulative 10-foot drawdown contour (**Figure 3.3-27**). The mitigation specified in Appendix A of the Betze Project SEIS (BLM 2003a) addressed all direct, indirect, and cumulative impacts within the projected maximum cumulative 10-foot drawdown contour (**Figure 3.3-27**). Therefore, the revised groundwater modeling for 2007 has not resulted in any new impacts to water resources beyond those that were discussed and covered by mitigation in the Betze Project SEIS (BLM 2000a, 2003a; Appendix A).

Cause of Slight Difference in 10-foot Drawdown Contour

Dewatering of the Betze Pit has been at a relatively constant rate for the past 3 to 5 years (Zhan 2007). Thus, the pumping rate of the dewatering wells near the pit has not changed significantly. BGMI frequently updates the groundwater model used to estimate impacts of pit dewatering based on the quarterly and annual monitoring well water level data. The groundwater model calibration is adjusted slightly to better match these new data each year. Thus, the BGMI groundwater model for the Betze Pit and the Boulder Valley area has been adjusted and recalibrated a number of times since the Year 2000. Recalibration of the model causes the drawdown contours to change shape and move somewhat either closer to or farther away from the Betze Pit.

Under the No Action Alternative, BGMI will continue the current dewatering of the Betze Pit for 4 additional years beyond 2011 holding water levels at or near their current elevation. Dewatering at the Betze Pit is now at or near steady state because groundwater levels have not changed in the past few years, so an additional 4 years of pumping is not anticipated to substantially change the nature or magnitude of drawdown around the pit or in the Boulder Valley area. **Figure 3.3-28** compares the maximum extent of 10-foot drawdown for groundwater pumping to Year 2011 vs. groundwater pumping for an additional 4 years to 2015 using BGMI's model from the Betze SEIS (BLM 2000a). This figure shows that the additional 4 years of pumping would not result in an expansion of groundwater drawdown. Recalibration of the groundwater model to changes in monitoring well water levels is a standard procedure for ensuring the accuracy of model predictions. This annual recalibration can lead to variations in the projected areal extent of groundwater drawdown, especially near the farthest extent of model predictions. Because the additional 4 years of pumping under the No Action Alternative for the Betze Pit is not expected to substantially change the nature of drawdown around the pit (Zhan 2007), the variation in the location of the 10-foot maximum drawdown contour between 2000 and 2007 is due to recalibration of the model between 2000 and 2007.

3.3.2.2 Proposed Action

Under the Proposed Action, the Betze Pit would be expanded to the northwest with two laybacks, as discussed in Chapter 2.0. This would result in 315 million tons of waste rock, and the proposed pit backfill would increase from 570 million tons (No Action Alternative) to 940 million tons under the Proposed Action. The pit backfill would be placed in three elevations or zones: 1) Lower Backfill for elevations below

5,116 feet amsl; 2) Middle Backfill for elevations between 5,116 feet and 5,246 feet amsl; and 3) Upper Backfi for elevations above 5,246 feet amsl (Schafer 2007). The pit backfill would be inundated during pit lake formation and below the final pit lake elevation after Year 100. The sequence of pit filling is shown in **Appendix C** (**Figures C-1** through **C-3**). The Lower Backfill zone would contain about 24 percent PAG waste rock (Schafer 2008b). The Middle Backfill zone would contain no PAG waste rock and would have an overall NNP of about 130 kg/t (Schafer 2007). The Upper Backfill zone would contain about 13 percent PAG (Schafer 2008b).

Post-mining Pit Lake

Under the Proposed Action, the area of the post-mining pit lake in the Betze Pit would be increased by 15 percent compared to the current Mine Plan (No Action Alternative), and the resulting pit lake would have a lower final elevation and about 90 percent of the volume of the pit lake under the existing mine plan. The Pit Lake surface area would be approximately 927 acres. The geochemical character of the pit walls would be different than Goldstrike's existing mine plan; the proposed expansion is at the northwest end of the Betze Pit and would involve mostly carbonate rock. The increase in backfill material to be left in the pit after mining compared to the existing mine plan would result in more PAG waste rock being left in the pit. However, the amount of PAG material in the remaining high walls of the post-mining pit would decrease from 15 percent under the existing mine plan to 12.5 percent under the Proposed Action (Schafer 2007). The average NNP for the pit highwall rocks would increase from 141 to 160-kg/t under the Proposed Action. The procedure for chemical modeling of the Proposed Action pit lake was the same as used for the No Action Alternative.

The Proposed Action pit lake water quality was analyzed for the two mine closure options: 1) without diversion of Rodeo Creek into the pit, and 2) with diversion of Rodeo Creek into the pit (**Figures 3.3-29** through **3.3-47**). The final pit lake elevation under the Proposed Action at steady state (Year 400) would be an estimated 5,111 feet amsl.

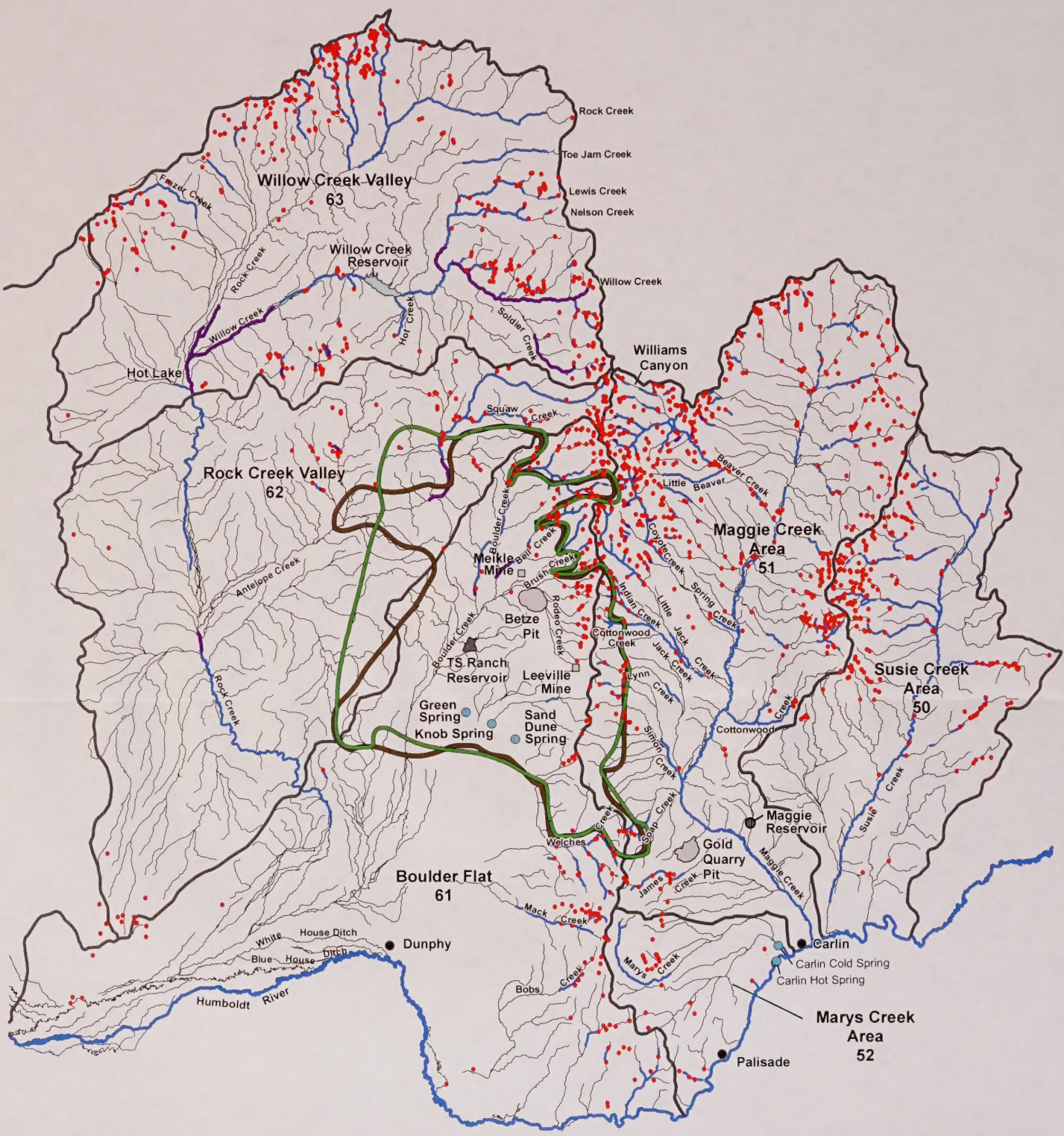
Without the diversion of Rodeo Creek, the first 14 years have pit wall runoff and precipitation as the main sources of water coming into the pit. Starting around Year 14, groundwater begins to enter the pit. By Year 20, groundwater becomes a dominant source of water flowing into the pit. Thus, the pit lake water quality begins to change between Years 14 and 20, and by Year 50 the pit lake water quality is dominated by inflowing groundwater and reactions between the inflowing groundwater and the pit walls. Also, precipitation of various phases controls the concentration of constituents such as arsenic, barium, iron, and calcium in the evolving pit lake water.

Water Quality with Rodeo Creek Diversion

Figures 3.3-29 through **3.3-47** show the changes in pit lake water quality with time for the Proposed Action with diversion of Rodeo Creek. With the closure option of the Rodeo Creek Diversion into the pit, the influx of Rodeo Creek controls the pit lake water quality during the first 20 years of pit filling. By Year 50, the pit lake water quality would begin to resemble the water quality under the Proposed Action without the Rodeo Creek Diversion, and the continued evolution of the pit water quality would follow a trend similar to that for the Proposed Action without the Rodeo Creek Diversion.

Modeling results show the pH of the pit lake would not be acidic, even during the early years of lake formation (**Figure 3.3-30**). Although not anticipated to be necessary, BGMI commits to adding 100-tons of limestone to the pit as a precautionary measure to ensure that the pit lake does not become acidic during these early years.

Pit lake water is not intended for use as drinking water nor agricultural water, nor has it been designated by NDEP for such uses. Comparison of predicted pit lake water to water quality standards based on use is provided below for informational purposes only. **Table 3.3-9** presents the concentration of major and minor constituents in the pit lake at Year 50. **Table 3.3-10** presents the same constituents at Year 400 in the pit lake. For the Expanded Pit with the Rodeo Creek Diversion, the pit lake water quality at Year 50 would exceed



3.3-42

Betze Pit Expansion Project

Figure 3.3-26

Areas of Perennial Stream Reaches, Seeps, and Springs in the Hydrologic Study Area and Comparison of 2000 and 2007 Maximum 10-foot Drawdown Extent

LEGEND

- Groundwater Basin Boundary
- Stream (Intermittent or Ephemeral)
- Perennial Stream Reach
- Discontinous Flowing Stream Reach
- Seeps and Springs
- Maximum Extent of 10-foot Drawdown Contour (2000 Model)
- Maximum Extent of 10-foot Drawdown Contour (2007 Model)

N

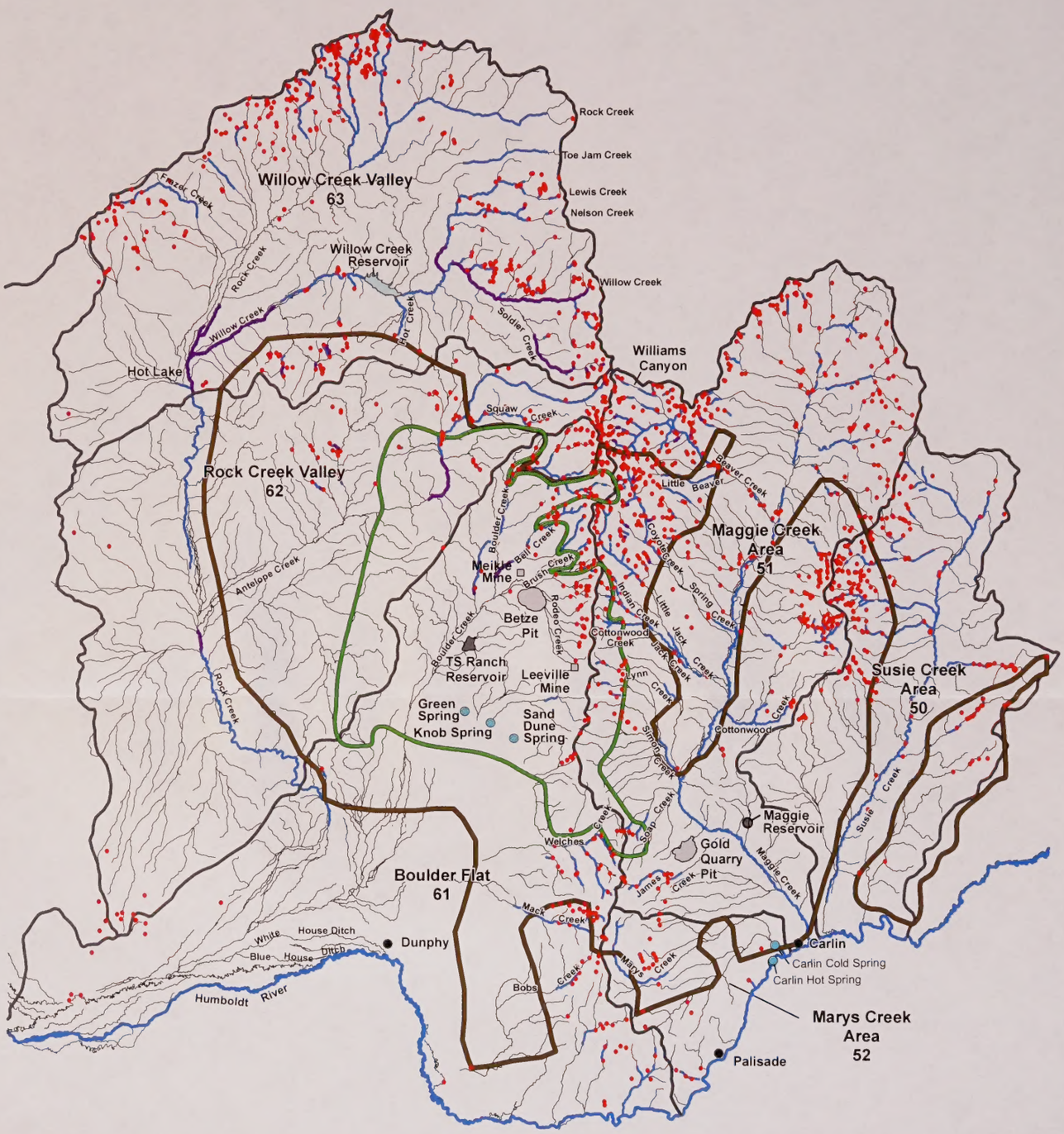
0 5 10 Miles

Note: Stream locations are taken from USGS line graph database. Hydrographic Area Boundary locations are approximate.

Source: BLM 2000a; BGMI 2007a.

06/17/2008





LEGEND

- Groundwater Basin Boundary
- Stream (Intermittent or Ephemeral)
- Perennial Stream Reach
- Discontinous Flowing Stream Reach
- Maximum Extent of Cumulative 10-foot Drawdown Contour (2000 Model)
- Maximum Extent of 10-foot Drawdown Contour (2007 Model)
- Seeps and Springs

N

0 5 10 Miles

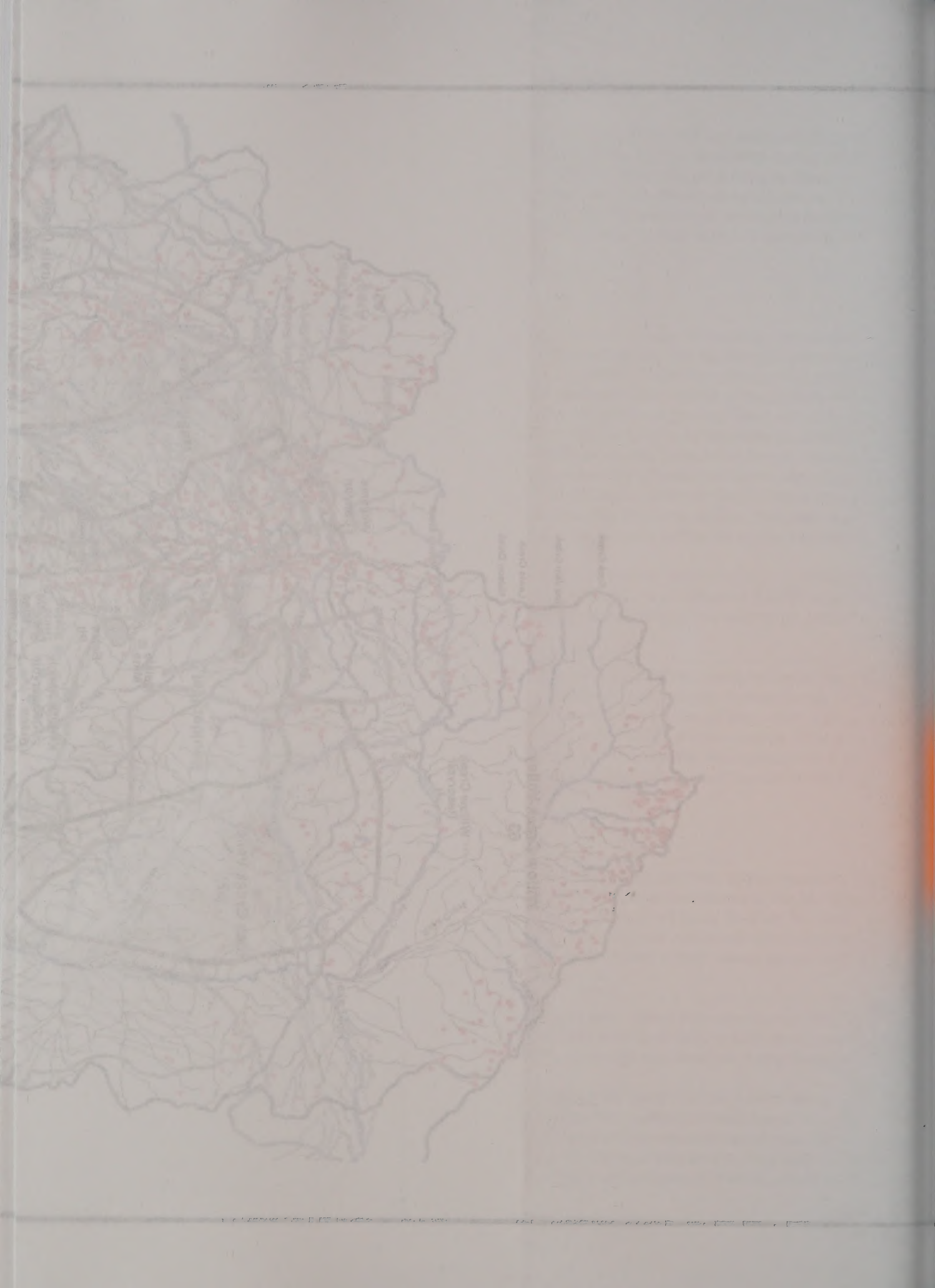
Note: Stream locations are taken from USGS line graph database. Hydrographic Area Boundary locations are approximate.
Source: BLM 2000a; BGMI 2007a.

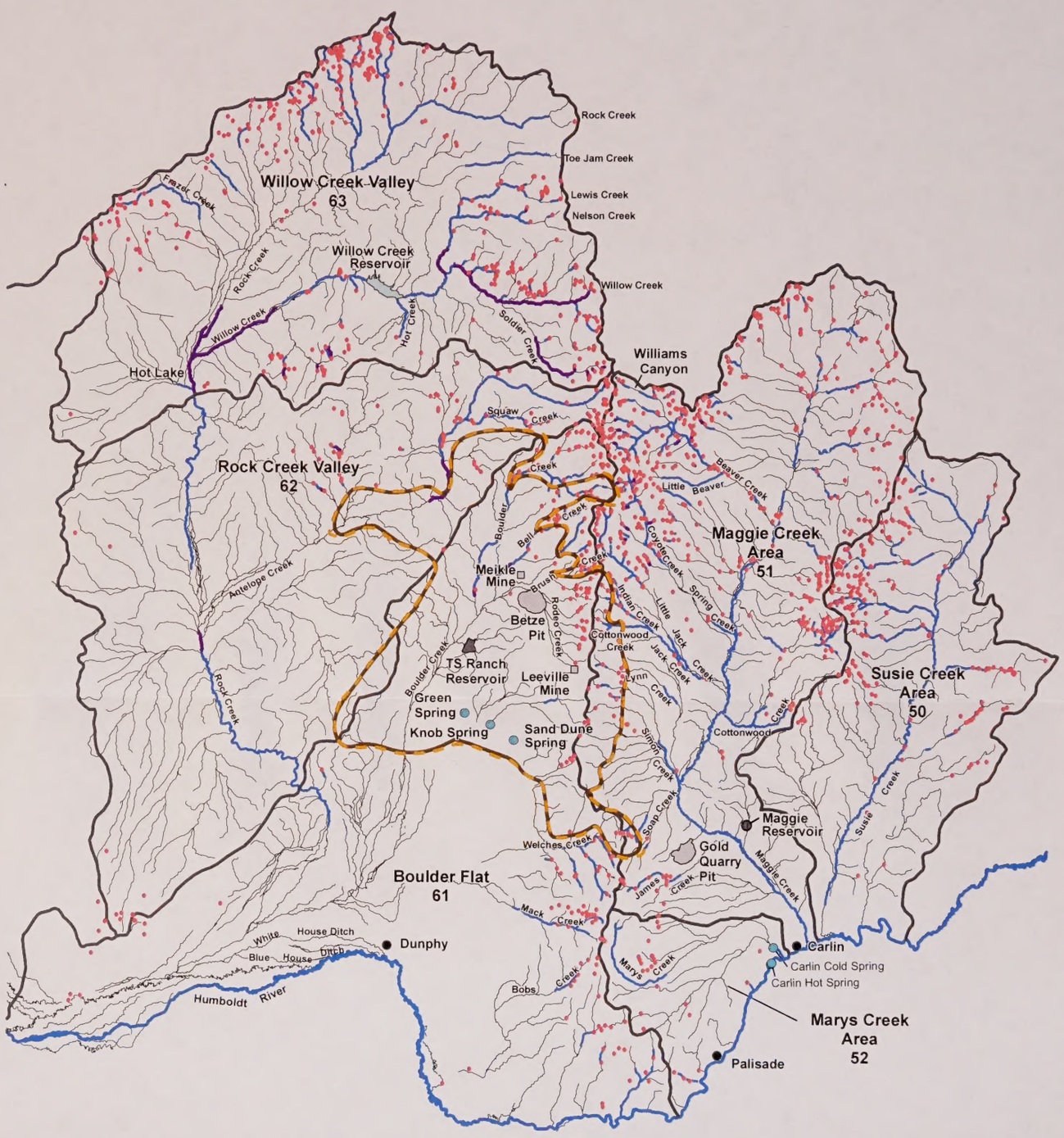
Betze Pit Expansion Project

Figure 3.3-27

Comparison of the 2007 10-foot Drawdown Contour (BGMI Pumping Only) and 2000 Cumulative Pumping 10-foot Drawdown Contour

06/20/2008





3.3-44

Betze Pit Expansion Project

Figure 3.3-28

Maximum Extent of 10-foot Drawdown Contours (Barrick Pumping Only) Pumping Case 2011 vs. 2015

LEGEND

- Maximum Extent of 10-foot Drawdown Contour, Pumping Case 2015 (2000 Model)
- Maximum Extent of 10-foot Drawdown Contour, Pumping Case 2011 (2000 Model)
- Groundwater Basin Boundary
- Stream (Intermittent or Ephemeral)
- Perennial Stream
- Discontinous Flowing Stream Reach
- Seeps and Springs

Note: The 2011 and 2015 10-foot drawdown contours are based on the Betze Project SEIS 2000 groundwater model. Stream locations are taken from USGS line graph database. Hydrographic Area Boundary locations are approximate.

Source: BLM 2000b; BGMI 2007a.

N

0 5 10 Miles

06/17/2008



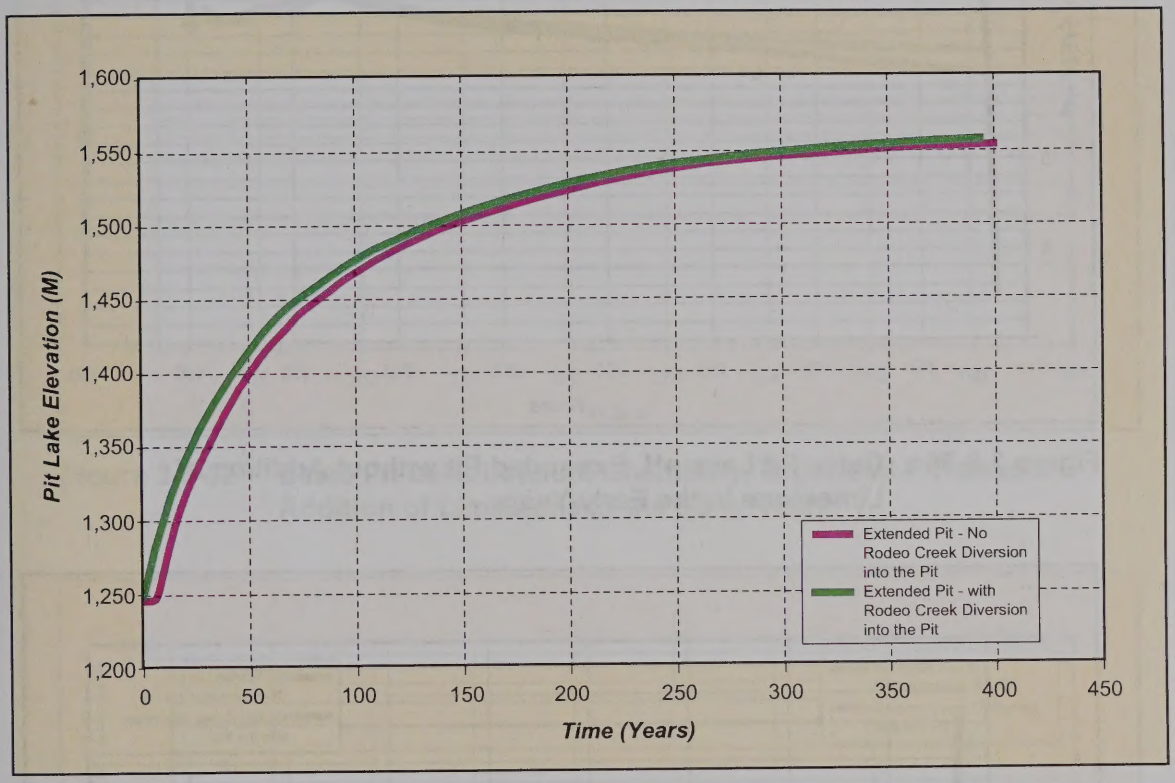


Figure 3.3-29 Comparison of Betze Pit Lake Elevation for the Expanded Pit with and without Diversion of Rodeo Creek

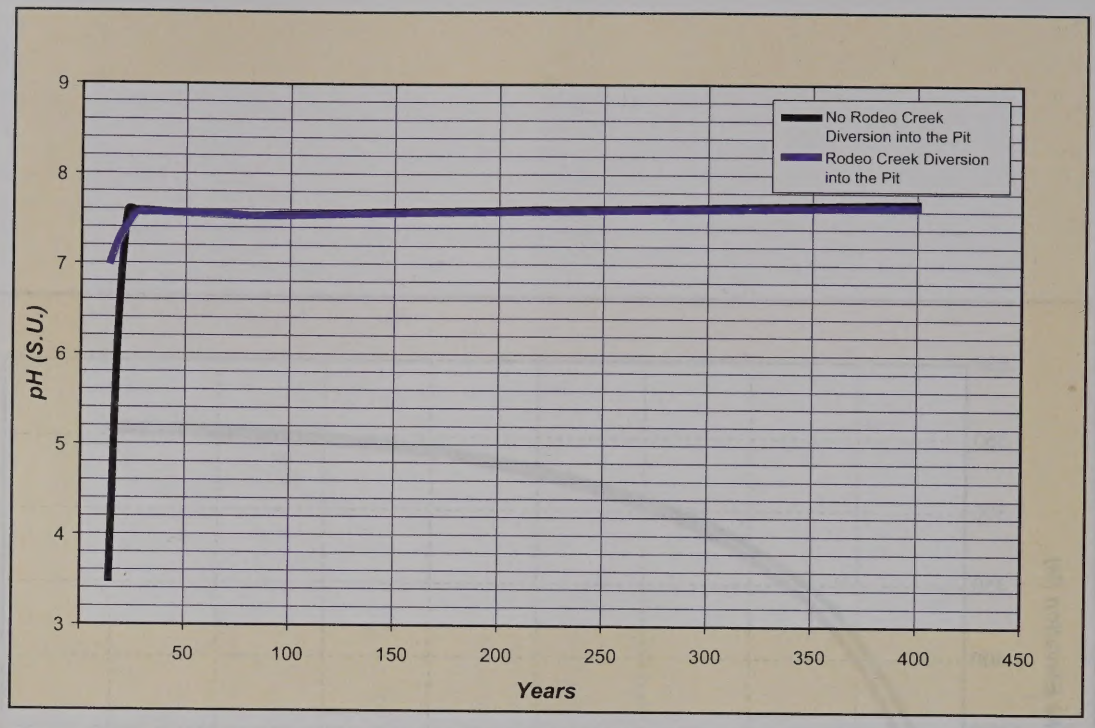


Figure 3.3-30 Betze Pit Lake pH, Expanded Pit without Addition of Limestone in the Early Years

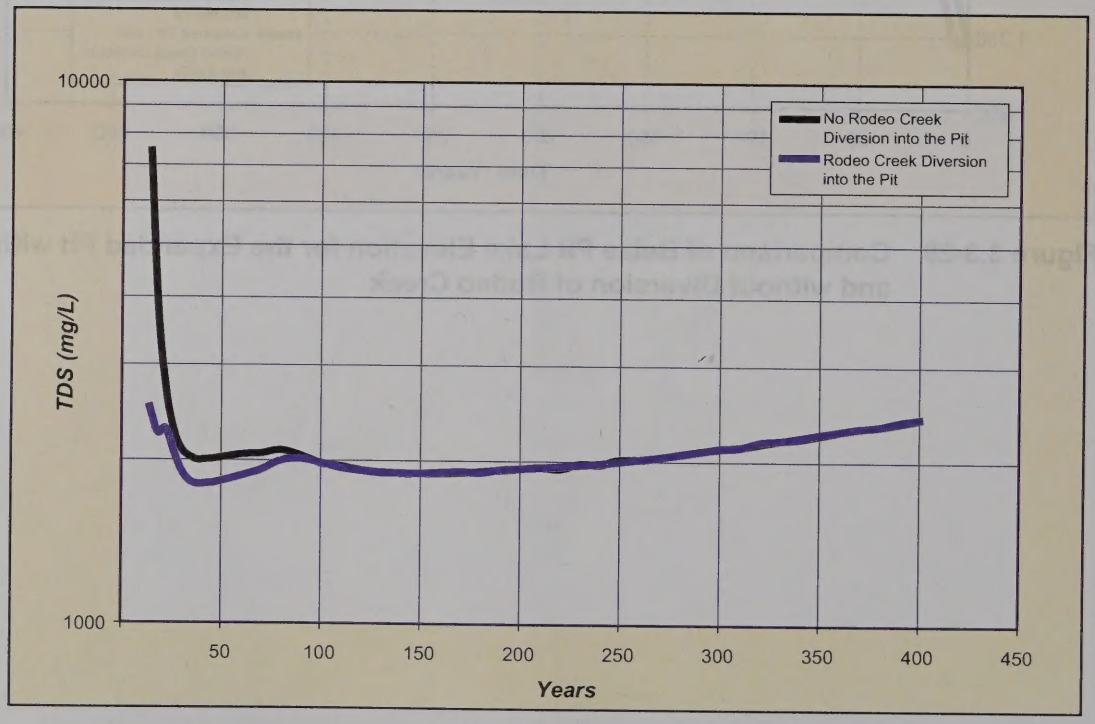


Figure 3.3-31 Betze Pit Lake Total Dissolved Solids, Expanded Pit without Addition of Limestone in the Early Years

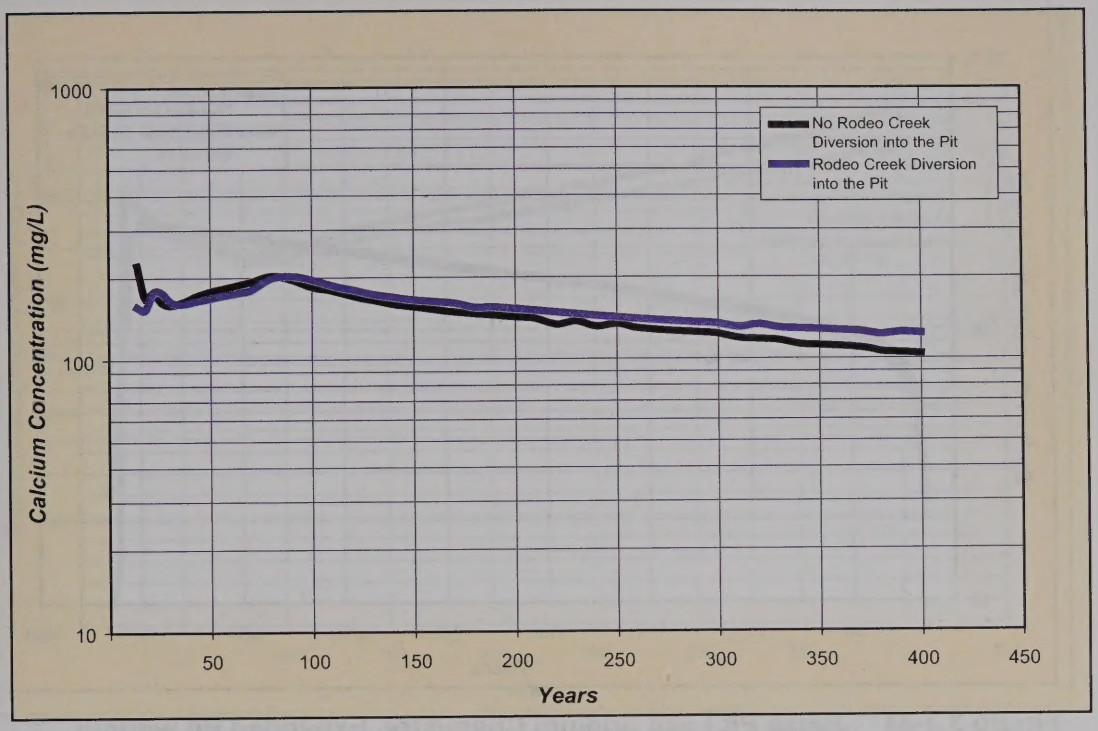


Figure 3.3-32 Betze Pit Lake Calcium Chemistry, Expanded Pit without Addition of Limestone in the Early Years

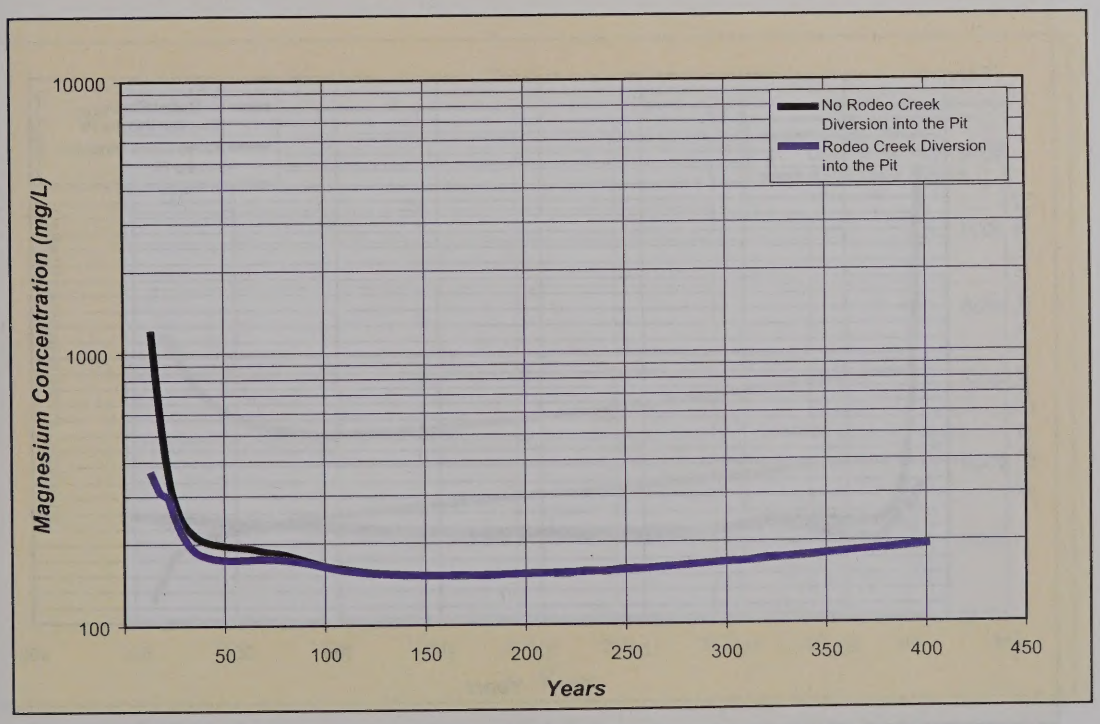


Figure 3.3-33 Betze Pit Lake Magnesium Chemistry, Expanded Pit without Addition of Limestone in the Early Years

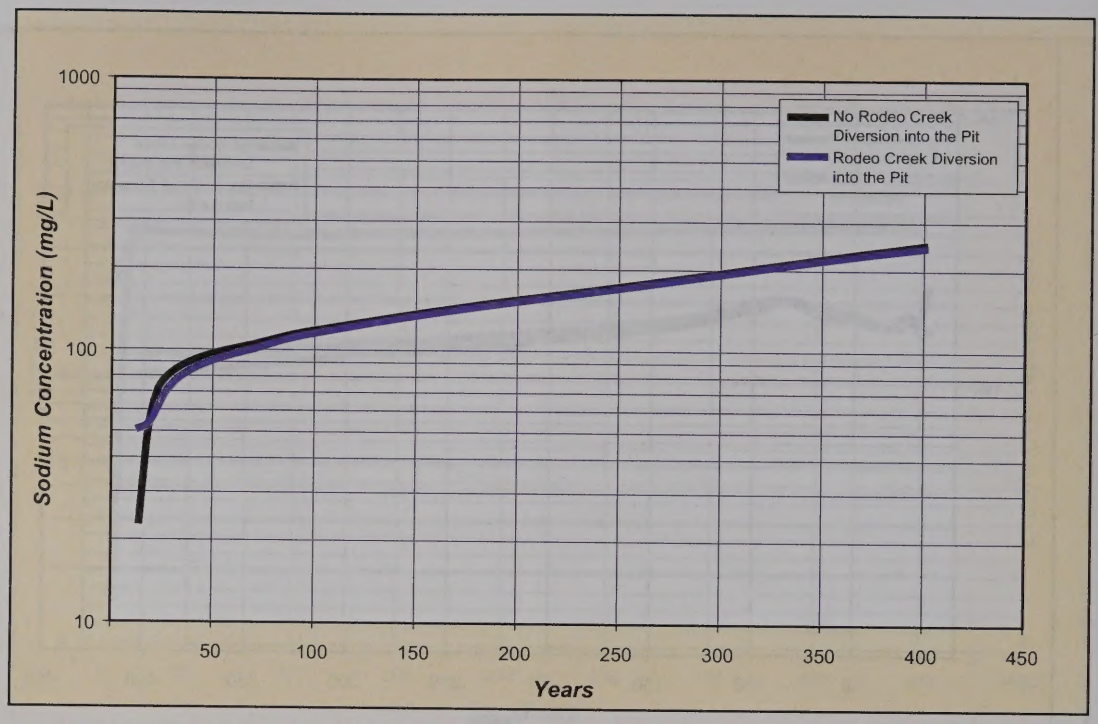


Figure 3.3-34 Betze Pit Lake Sodium Chemistry, Expanded Pit without Addition of Limestone in the Early Years

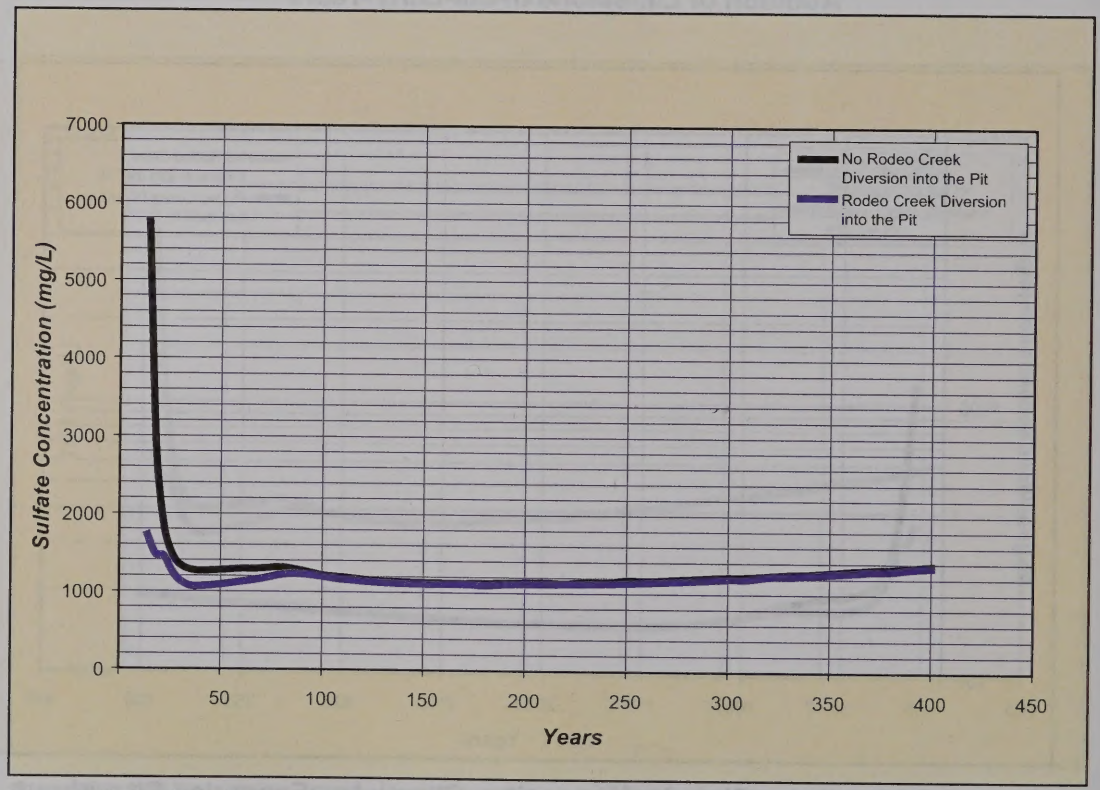


Figure 3.3-35 Betze Pit Lake Sulfate Chemistry, Expanded Pit without Addition of Limestone in the Early Years

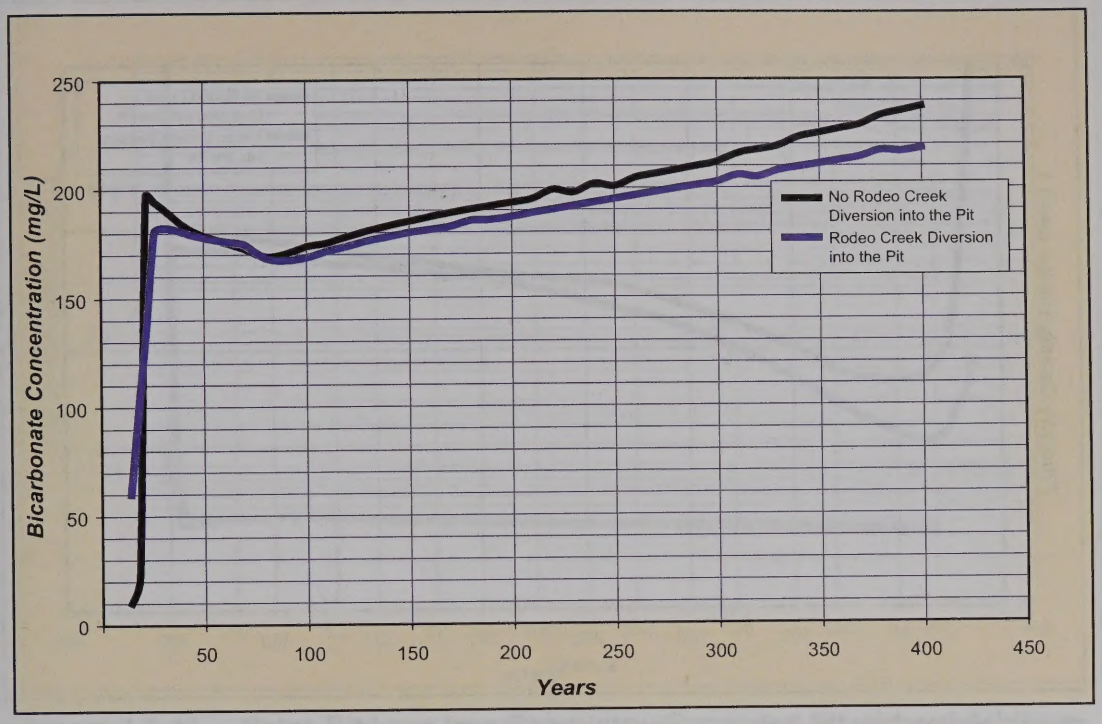


Figure 3.3-36 **Betze Pit Lake Bicarbonate Chemistry, Expanded Pit without Addition of Limestone in the Early Years**

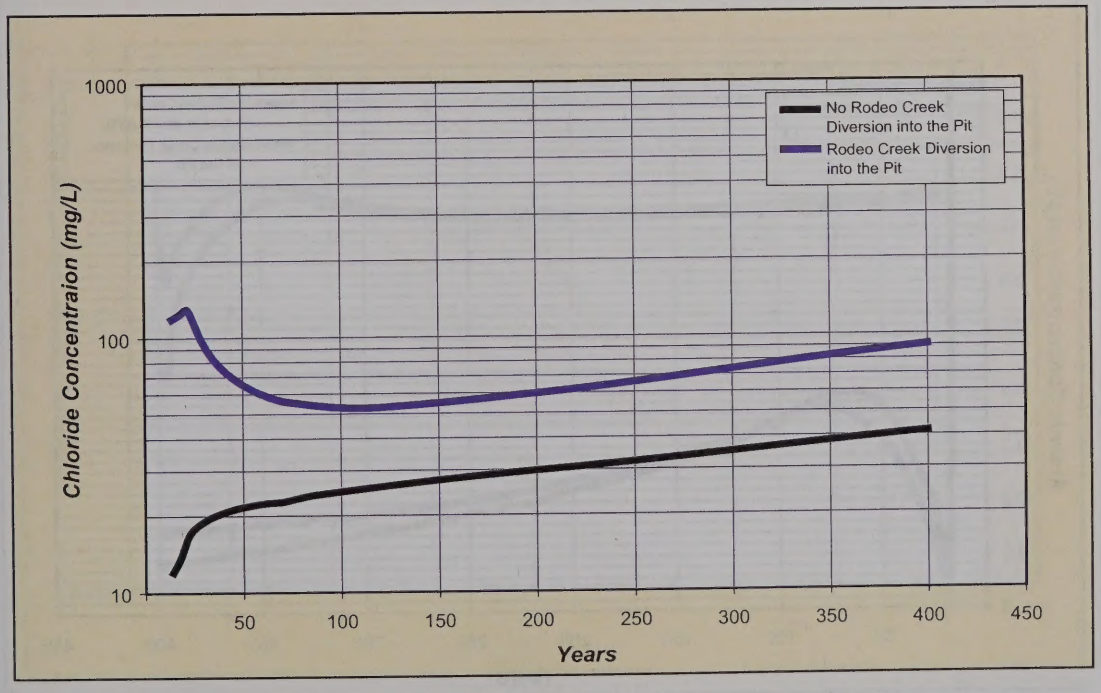


Figure 3.3-37 **Betze Pit Lake Chloride Chemistry, Expanded Pit without Addition of Limestone in the Early Years**

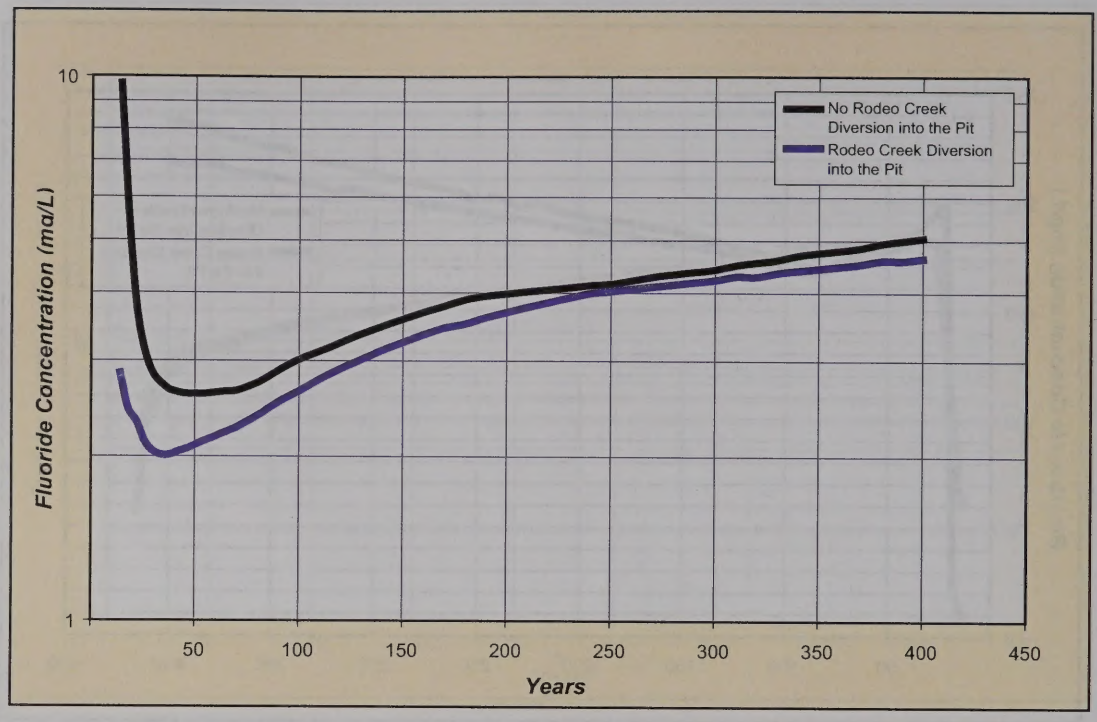


Figure 3.3-38 Betze Pit Lake Fluoride Chemistry, Expanded Pit without Addition of Limestone in the Early Years

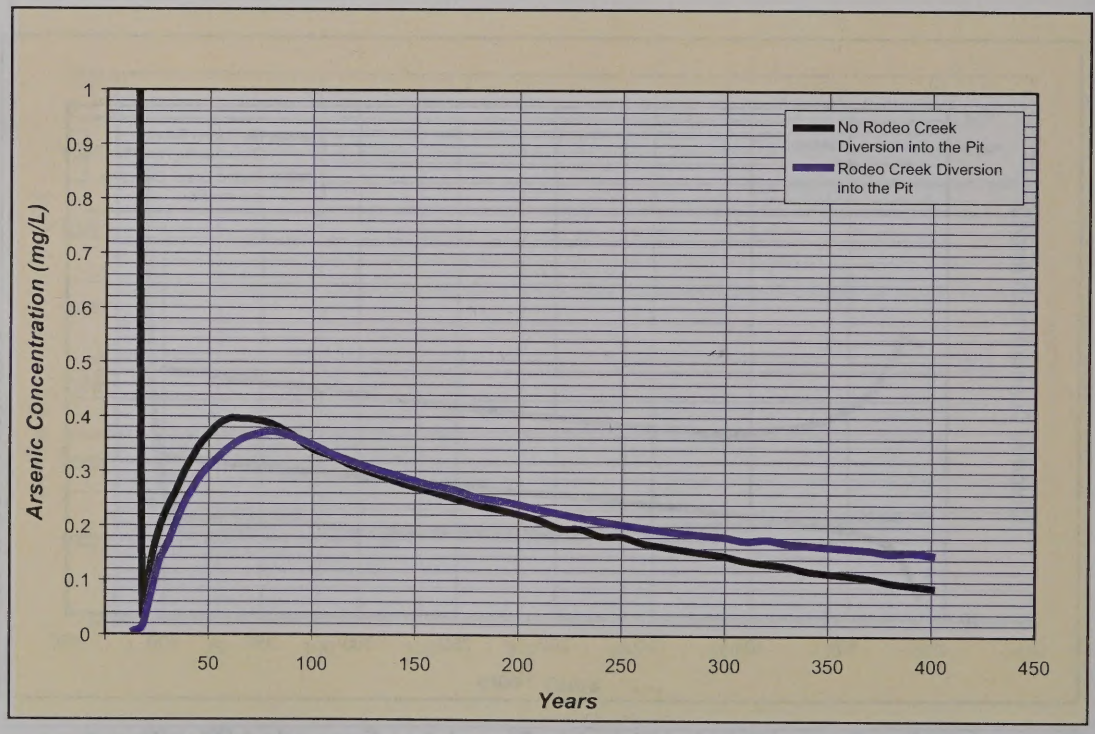


Figure 3.3-39 Betze Pit Lake Arsenic Chemistry, Expanded Pit without Addition of Limestone in the Early Years

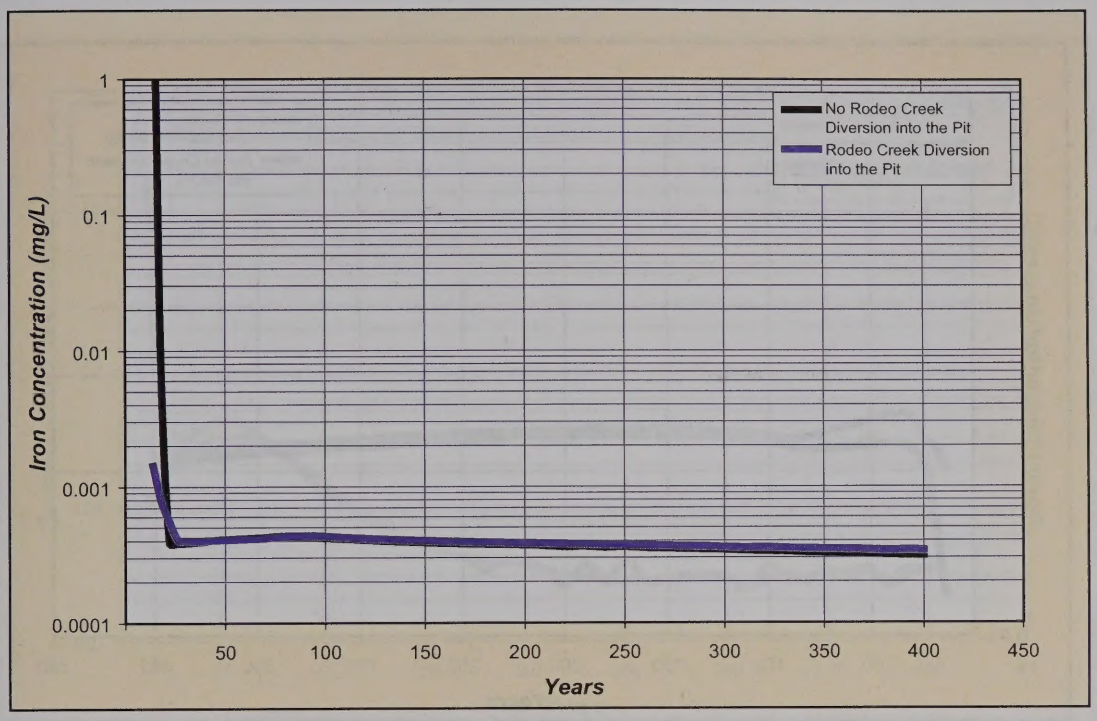


Figure 3.3-40 **Betze Pit Lake Iron Chemistry, Expanded Pit without Addition of Limestone in the Early Years**

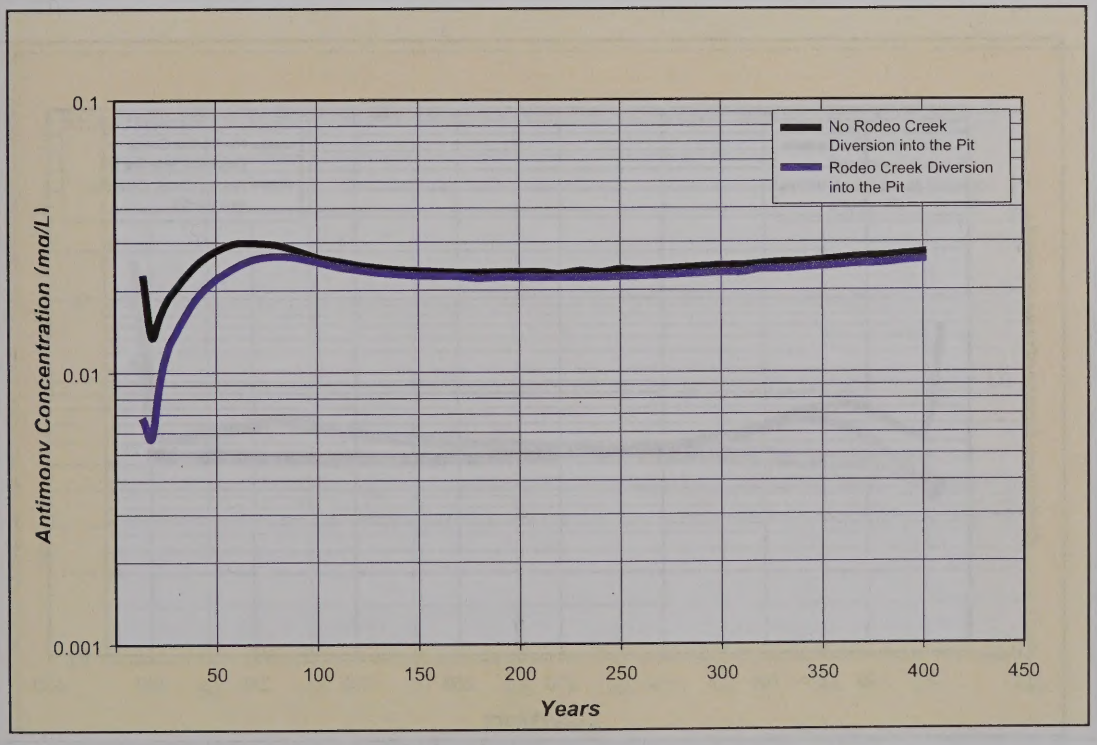


Figure 3.3-41 **Betze Pit Lake Antimony Chemistry, Expanded Pit without Addition of Limestone in the Early Years**

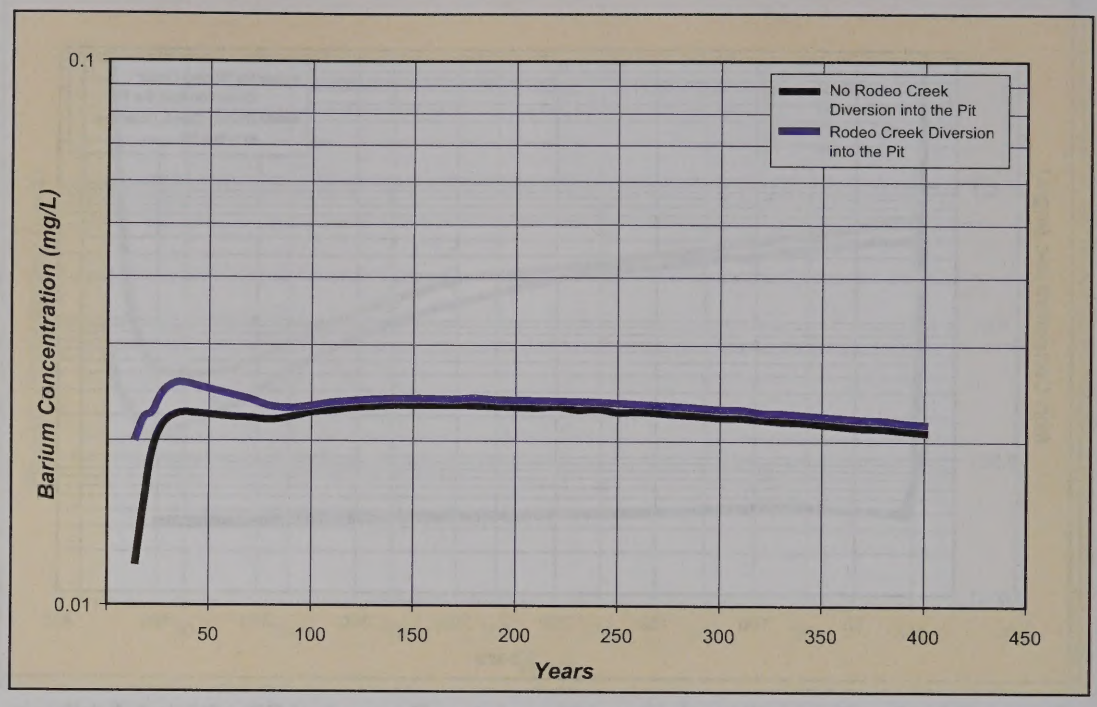


Figure 3.3-42 Betze Pit Lake Barium Chemistry, Expanded Pit without Addition of Limestone in the Early Years

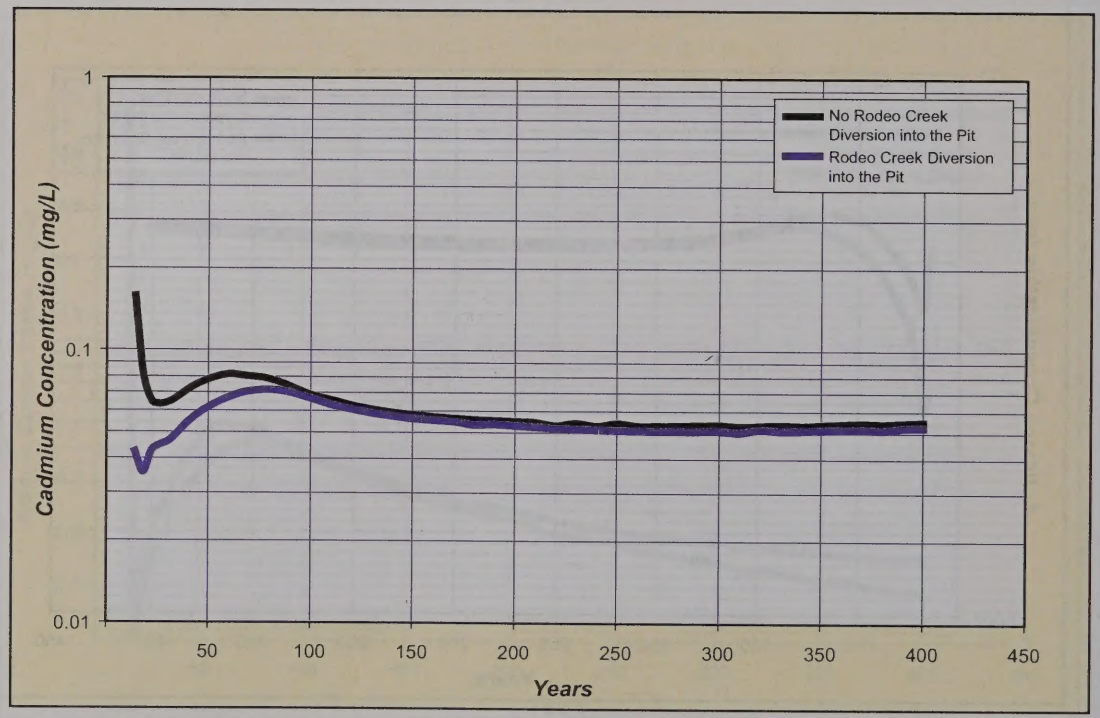


Figure 3.3-43 Betze Pit Lake Cadmium Chemistry, Expanded Pit without Addition of Limestone in the Early Years

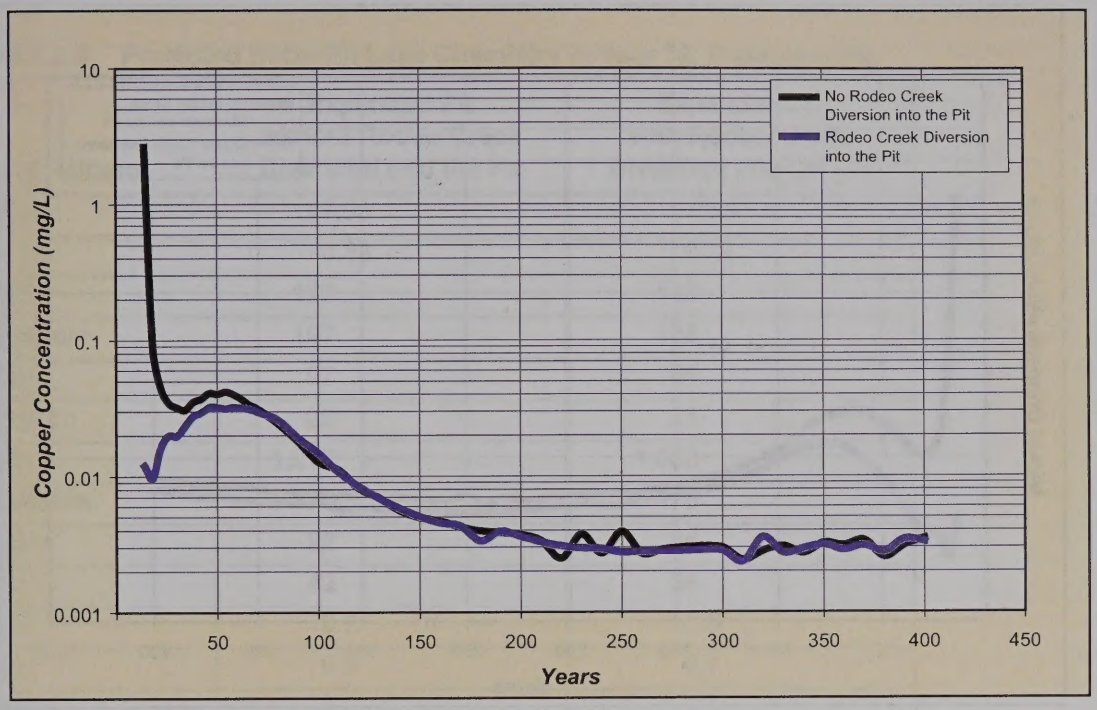


Figure 3.3-44 Betze Pit Lake Copper Chemistry, Expanded Pit without Addition of Limestone in the Early Years

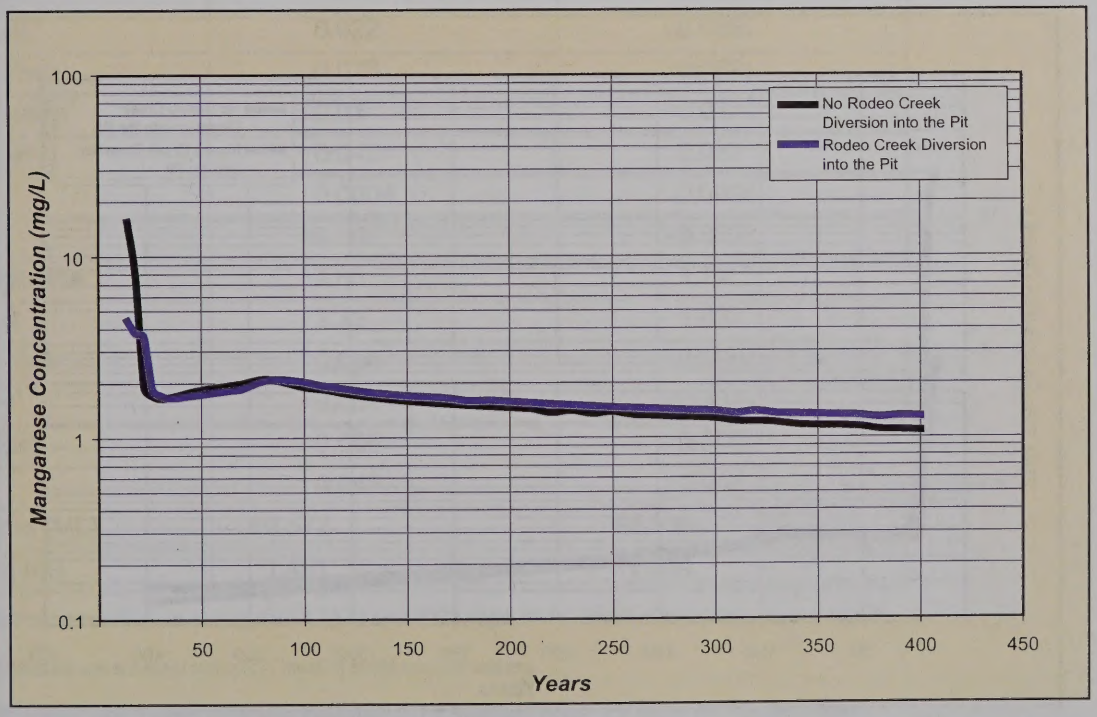


Figure 3.3-45 Betze Pit Lake Manganese Chemistry, Expanded Pit without Addition of Limestone in the Early Years

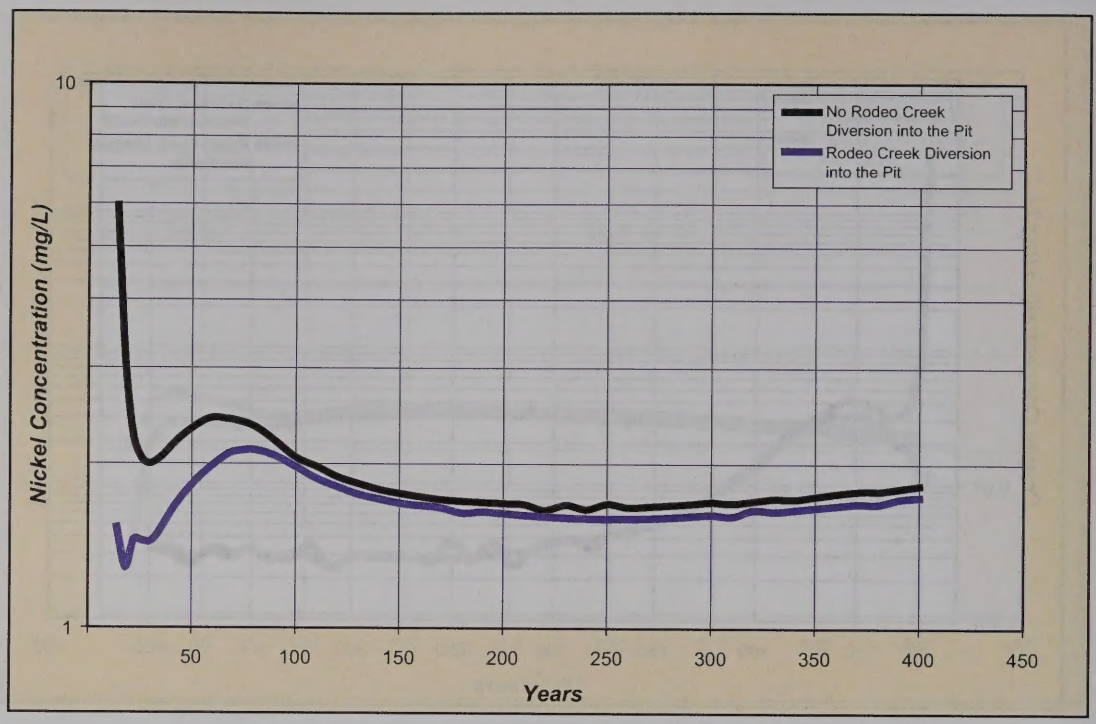


Figure 3.3-46 Betze Pit Lake Nickel Chemistry, Expanded Pit without Addition of Limestone in the Early Years

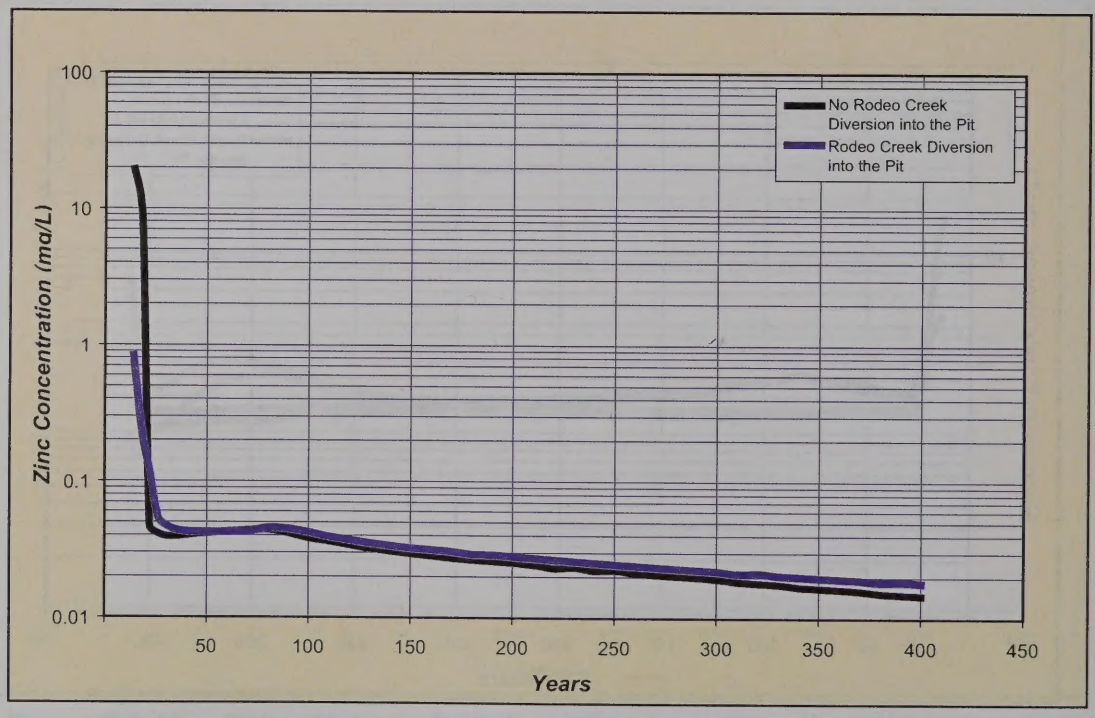


Figure 3.3-47 Betze Pit Lake Zinc Chemistry, Expanded Pit without Addition of Limestone in the Early Years

Table 3.3-9 Predicted Betze Pit Lake Chemistry in Year 50, Expanded Pit

Constituent	Expanded Pit without Rodeo Creek Diversion into the Pit	Expanded Pit with Rodeo Creek Diversion into the Pit
pH (SU)	7.56	7.56
ORP (V)	0.33	0.33
Calcium	179	169
Magnesium	197	174
Sodium	97	91
Potassium	25	21
Sulfate	1,277	1,088
Bicarbonate	179	178
Chloride	22	65
Silica	42	36
Nitrate	0.5	0.5
Boron	0.9	0.7
Fluoride	2.6	2.1
Aluminum	0.006	0.005
Antimony	0.028	0.022
Arsenic[1]	0.368	0.309
Barium	0.022	0.025
Cadmium	0.078	0.062
Chromium[2]	<0.01	<0.01
Copper	0.040	0.032
Iron	0.0004	0.0004
Lead[2]	<0.002	<0.002
Manganese	1.85	1.74
Nickel	2.32	1.83
Selenium	0.008	0.008
Silver[2]	<0.004	<0.004
Thallium	0.006	0.005
Zinc	0.042	0.042
Volume (ML)	59,572	62,336
Stage (m)	1,401	1,404

[1] Based on comparison to analogous pit lakes and 2002 batch tests, model overpredicts arsenic levels.

[2] Constituents were below detection level in most source waters.

Notes: Units = mg/L unless otherwise indicated; SU = Standard Units; V = Volts; ML = million liters; M = meters.

Source: Schafer 2007.

Table 3.3-10 Predicted Betze Pit Lake Chemistry in Year 400, Expanded Pit

Constituent	Expanded Pit without Rodeo Creek Diversion into the Pit	Expanded Pit with Rodeo Creek Diversion into the Pit
pH (SU)	7.69	7.65
ORP (V)	0.32	0.33
Calcium	104	124
Magnesium	193	194
Sodium	249	243
Potassium	68	62
Sulfate	1,376	1,354
Bicarbonate	237	218
Chloride	42	91
Silica	125	112
Nitrate	2.0	1.9
Boron	3.3	3.0
Fluoride	5.1	4.6
Aluminum	0.007	0.006
Antimony	0.028	0.026
Arsenic[1]	0.089	0.149
Barium	0.021	0.022
Cadmium	0.055	0.052
Chromium[2]	<0.00013	<0.00014
Copper	0.003	0.003
Iron	0.0003	0.0003
Lead[2]	<0.00011	<0.00012
Manganese	1.08	1.30
Nickel	1.83	1.74
Selenium	0.008	0.008
Silver[2]	<0.009	<0.009
Thallium	<0.006	<0.006
Zinc	0.015	0.018
Volume (ML)	420,170	435,330
Stage (m)	1,554	1,558

[1] Based on comparison to analogous pit lakes and 2002 batch tests, model overpredicts arsenic levels.

[2] Constituents were below detection level in most source waters.

Notes: Units = mg/L unless otherwise indicated; SU = Standard Units; V = Volts; ML = million liters; M = meters.

Source: Schafer 2007.

Nevada drinking water standards for TDS (1,850 mg/L); sulfate (1,088 mg/L); fluoride (2.1 mg/L); antimony (0.022 mg/L); arsenic (0.309 mg/L); cadmium (0.062 mg/L); manganese (1.74 mg/L); and selenium (1.80 mg/L). The pit lake would exceed Nevada irrigation and stock water standards (**Table B-1**) for arsenic, cadmium, nickel, fluoride, and selenium, and irrigation standards for manganese. Wildlife propagation standards would not be exceeded. At Year 400, the pit lake with the Rodeo Creek Diversion would exceed Nevada drinking water standards for TDS (2,500 mg/L); sulfate (1,354 mg/L); boron (3.0 mg/L); fluoride (4.6 mg/L); antimony (0.026 mg/L); arsenic (0.149 mg/L); cadmium (0.052 mg/L); manganese (1.3 mg/L); and nickel (1.74 mg/L). The pit lake would exceed Nevada irrigation and stock water standards for arsenic, boron (irrigation only), cadmium, manganese (irrigation only), nickel (irrigation only), and fluoride. The water would not exceed wildlife propagation standards. An ecological risk assessment summary on the pit lake water is presented in Section 3.8, Wildlife Resources.

Water Quality without Rodeo Creek Diversion

Figures 3.3-29 to **3.3-47** show changes in pit lake water quality for the Betze pit lake without diversion of Rodeo Creek into the pit. **Table 3.3-9** shows the expected composition of the pit lake at 50 years for the Proposed Action without the diversion of Rodeo Creek. Sulfate in the pit lake would be around 1,277 mg/L; antimony would be at 0.028 mg/L; fluoride would be 2.6 mg/L; arsenic would be at 0.368 mg/L; cadmium 0.078 mg/L; copper at 0.04 mg/L; and nickel at 2.32 mg/L. The pit lake would exceed current Nevada drinking water standards for TDS, sulfate, antimony, arsenic, nickel, and cadmium. The pit lake would exceed irrigation standards for arsenic, boron, cadmium, manganese, nickel, and fluoride. The pit lake would exceed stock water standards for arsenic, cadmium, and fluoride. The pit lake would not exceed wildlife propagation standards. **Table 3.3-10** gives the composition of the pit lake under the Proposed Action without the Rodeo Creek Diversion at 400 years. In this case, the pit lake would exceed current Nevada drinking water standards for TDS (2,500 mg/L); antimony (0.028 mg/L); arsenic (0.089 mg/L); cadmium (0.055 mg/L); nickel (1.83 mg/L); fluoride (5.1 mg/L); and sulfate (1,376 mg/L). The pit lake also would exceed irrigation standards for arsenic, boron, cadmium, manganese, nickel, and fluoride. Stock water standards would be exceeded for arsenic, cadmium, and fluoride. Wildlife propagation standards would not be exceeded. Without the Rodeo Creek Diversion, the pit lake would be acidic and metal-laden during the first 20 years of pit lake formation. Once groundwater enters the pit after Year 20, the pit lake would gradually reflect the dominance of the groundwater chemistry and by Year 50 the pit lake would be comparable to the pit lake under the Proposed Action with the Rodeo Creek Diversion.

The pit lake modeling conducted by BGMI (Schafer 2007) evaluated empirical test results on mine water from Goldstrike and concluded that the geochemical modeling may over-predict the concentrations of some elements in the future pit lake. The constituents that may be over-predicted were arsenic, antimony, and cadmium (Schafer 2007). Predicting the future water quality of a pit lake requires assumptions about reaction mechanisms between solids and water flowing into a pit through the pit walls, the pit floor, or down the pit walls as pit wall runoff. The pit lake modeling completed for BGMI by Schafer (2007) made every effort to calibrate the geochemical model to the results of laboratory column tests and batch mixing tests. The conclusion in the pit lake report of Schafer (2007) that some constituents may be over-predicted is reasonable. Thus, concentrations given for arsenic, antimony, and cadmium in the text and tables of this report should be considered as very conservative estimates.

To offset the expected acidity of the pit lake water during the first 14 years of pit lake formation under the Proposed Action without the diversion of Rodeo Creek, BGMI proposes to add approximately 100 tons of crushed limestone to the pit. This would neutralize the acidity, and the initial pit lake water quality would have a pH around 7.0 to 7.5 standard units and stay in that range for the remainder of the future of the pit lake (Schafer 2007). Sulfate, however, would follow a pattern similar to the Proposed Action without the diversion of Rodeo Creek and start around 9,000 mg/L. **Table 3.3-11** shows the expected pit lake water quality from Year 5 to Year 13 for the pit lake without the diversion of Rodeo Creek and without the addition of limestone. **Table 3.3-12** shows the benefit of adding limestone.

Table 3.3-11 Predicted Betze Pit Lake Chemistry During Early Stage Filling (Years 5 to 13) without Limestone Addition

Constituent	Year								
	5	6	7	8	9	10	11	12	13
pH (SU)	3.39	3.56	3.66	3.88	4.37	4.86	7.01	7.41	7.57
ORP (V)	0.46	0.43	0.42	0.40	0.38	0.38	0.23	0.25	0.25
Calcium	385	184	137	82	98	99	100	101	102
Magnesium	2,052	982	730	436	436	373	319	277	245
Sodium	37	18	13	8	19	28	36	42	47
Potassium	3.9	0.7	0.3	0.03	0.0002	0.001	4.9	8.1	10.3
Sulfate	10,075	4,815	3,579	2,138	2,129	1,801	1,551	1,349	1,197
Bicarbonate	5.6	4.9	4.7	4.7	5.0	5.8	38.0	101.4	148.3
Chloride	20.1	9.7	7.2	4.4	6.7	8.2	9.2	10.1	10.8
Silica	39.2	18.8	14.0	8.3	13.6	17.9	19.0	21.8	24.1
Nitrate	0.8	1.7	2.0	2.4	2.2	1.9	1.7	1.6	1.4
Boron	0.12	0.06	0.04	0.03	0.13	0.23	0.32	0.38	0.44
Fluoride	16.57	7.93	5.89	3.52	3.67	3.33	3.03	2.78	2.60
Aluminum	108.4	49.4	36.2	21.4	15.2	3.6	0.0	0.0	0.0
Antimony	0.038	0.018	0.013	0.008	0.009	0.008	0.007	0.006	0.006
Arsenic	3.043	1.456	1.083	0.647	0.465	0.235	0.018	0.002	0.001
Barium	0.022	0.019	0.014	0.008	0.028	0.041	0.051	0.040	0.039
Cadmium	0.270	0.129	0.096	0.057	0.057	0.048	0.041	0.034	0.030
Chromium	0.215	0.103	0.077	0.046	0.025	0.002	0.0003	0.0001	0.0001
Copper	4.561	2.182	1.623	0.971	0.966	0.802	0.097	0.024	0.019
Iron	152.2	72.8	54.2	32.4	20.7	1.7	0.0002	0.0001	0.0001
Lead	0.005	0.002	0.002	0.001	0.001	0.001	0.0001	0.00003	0.00003
Manganese	27.0	12.9	9.6	5.7	5.7	4.9	4.2	3.3	1.5
Nickel	10.2	4.9	3.6	2.2	2.2	1.9	1.6	1.3	1.1
Selenium	0.324	0.155	0.115	0.069	0.067	0.053	0.040	0.028	0.021
Silver	0.008	0.004	0.003	0.002	0.002	0.002	0.002	0.002	0.002
Thallium	0.006	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.001
Zinc	33.1	15.8	11.8	7.0	7.0	5.9	0.45	0.078	0.037
Volume (Millions of liters)	0.9	2.4	28	131	317	565	865	1,227	1,635
Stage (m)	1,247	1,248	1,253	1,258	1,265	1,271	1,277	1,282	1,288

Notes: SU = Standard Units; V = Volts; m = meters; All metals in mg/L.

Source: Schafer 2007.

Table 3.3-12 Predicted Betze Pit Lake Chemistry During Early Stage Filling (Years 5 to 13) with Limestone Addition

Constituent	Year								
	5	6	7	8	9	10	11	12	13
pH (SU)	7.46	7.40	7.43	7.19	7.37	7.30	7.49	7.59	7.61
ORP (V)	0.22	0.20	0.19	0.21	0.20	0.23	0.20	0.24	0.25
Calcium	458	419	321	186	190	152	134	125	111
Magnesium	2,049	980	729	436	435	372	319	277	245
Sodium	37	18	13	8	19	28	36	42	47
Potassium	14.1	6.8	5.0	3.02	5.8716	8.478	10.4	12.0	13.3
Sulfate	9,165	4,837	3,601	2,152	2,158	1,845	1,580	1,369	1,213
Bicarbonate	130.6	99.6	100.3	55.7	83.9	75.6	105.7	148.5	161.1
Chloride	20.1	9.7	7.2	4.4	6.7	8.2	9.2	10.1	10.8
Silica	24.1	11.6	8.6	5.3	10.5	15.3	18.8	21.8	24.1
Nitrate	0.8	1.7	2.0	2.4	2.2	1.9	1.7	1.6	1.4
Boron	0.12	0.06	0.04	0.03	0.13	0.23	0.32	0.38	0.44
Fluoride	10.12	7.31	5.89	3.52	3.67	3.33	3.03	2.78	2.60
Aluminum	0.013	0.016	0.019	0.011	0.014	0.008	0.017	0.011	0.009
Antimony	0.038	0.018	0.013	0.008	0.009	0.008	0.007	0.006	0.006
Arsenic	0.005	0.002	0.002	0.002	0.001	0.002	0.001	0.001	0.001
Barium	0.022	0.019	0.014	0.008	0.028	0.042	0.052	0.040	0.039
Cadmium	0.254	0.120	0.089	0.054	0.053	0.045	0.038	0.033	0.029
Chromium	0.0004	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Copper	0.048	0.029	0.026	0.015	0.018	0.014	0.018	0.020	0.020
Iron	0.0001	0.001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Lead	0.00003	0.00001	0.00001	0.00001	0.00001	0.00001	0.00002	0.00003	0.00003
Manganese	8.5	6.6	4.8	5.0	4.8	4.4	2.4	1.5	1.3
Nickel	8.2	4.0	3.0	1.9	1.9	1.6	1.4	1.2	1.0
Selenium	0.061	0.035	0.027	0.022	0.020	0.018	0.015	0.013	0.012
Silver	0.008	0.004	0.003	0.002	0.002	0.002	0.002	0.002	0.002
Thallium	0.006	0.003	0.002	0.001	0.001	0.001	0.001	0.001	0.001
Zinc	0.2	0.2	0.1	0.4	0.1	0.2	0.05	0.037	0.032
Volume (Millions of liters)	0.9	2.4	28	131	317	565	865	1,227	1,635
Stage (m)	1,247	1,248	1,253	1,258	1,265	1,271	1,277	1,282	1,288

Notes: SU = Standard Units; V = Volts; M = meters; All metals in mg/L.

Source: Schafer 2007.

Without the addition of limestone, the pit lake at Year 5 would exceed current Nevada drinking water standards for pH, TDS, sulfate, fluoride, antimony, arsenic, cadmium, and other metals. For irrigation standards, the pit lake water would exceed arsenic, cadmium chromium copper, iron, manganese, nickel, selenium, zinc, and fluoride standards at Year 5. For stock water, only arsenic, cadmium, chromium, copper, selenium, zinc, and fluoride standards would be exceeded. Wildlife propagation standards would not be exceeded. As previously indicated, pit lake water is not intended for drinking water or agricultural water uses, nor has it been designated for such use by NDEP. By Year 13, the pit lake would approach the composition of pit lake water with the addition of limestone under the Proposed Action without the diversion of Rodeo Creek.

With the addition of limestone, only antimony, cadmium, nickel, selenium, sulfate, TDS, and fluoride standards would be exceeded at Year 5 for current Nevada drinking water standards. Irrigation standards for cadmium, manganese, nickel, selenium, and fluoride would be exceeded at Year 5. For stock water, only cadmium, selenium, and fluoride standards would be exceeded at Year 5 with the addition of limestone. The wildlife propagation standards would not be exceeded. By Year 13, the pit lake would exceed current Nevada drinking water standards for TDS, sulfate, fluoride (secondary standard), arsenic, cadmium, manganese (secondary standard), and nickel. The pit lake would exceed irrigation water standards for fluoride, arsenic, manganese, and nickel. The stock water standards would be exceeded for only fluoride and arsenic. Wildlife propagation standards would not be exceeded.

The addition of limestone to the pit under the Proposed Action in the event the diversion of Rodeo Creek is not permitted by the Nevada State Engineer or the NDEP would prevent the formation of an acid pit lake during the first 14 years of pit lake history. After Year 14, groundwater would enter the pit and control the pit lake chemistry. Sulfate would not be affected by the addition of limestone, but most other constituents of concern would be lowered in concentration in the initial pit lake (**Tables 3.3-11** and **3.3-12**). The pit lake would, however, still exceed irrigation and stock water standards for many key constituents. Section 3.8, Wildlife Resources, discusses the environmental risks posed by the pit lake for wildlife and stock use of the water.

At full recovery, which would be approximately 400 years after cessation of pumping at the Goldstrike Mine, the drawdown created by evaporation from the Betze Pit lake under the Proposed Action would be somewhat different than under the No Action Alternative. Under the Proposed Action with the expanded Betze Pit, the pit lake would be about 15 percent larger in surface area than under the No Action Alternative. This would result in a maximum 10-foot drawdown pattern at recovery as shown in **Figure B-3**. Compared to the No Action Alternative, the expanded pit under the Proposed Action would create a 10-foot maximum drawdown at recovery that would extend farther to the northwest and somewhat farther to the southeast. The 10-foot drawdown would extend less to the southwest along Antelope Creek. Part of this change in configuration of the 10-foot maximum drawdown at recovery is due to the expanded area of the pit lake, and part is due to recalibration of the groundwater model from 2000 to 2007.

Clydesdale Waste Rock Facility

According to the BGMI 2007 block model for the Betze Pit, PAG rocks would account for about 19 percent of the rocks mined in the proposed laybacks (Schafer 2008a). In the proposed Clydesdale Waste Rock Facility, PAG rocks would comprise about 7 percent of the total waste rock and would be encapsulated in the waste rock facility, as discussed in Chapter 2.0. This would prevent oxidation or leaching of the PAG material and prevent the generation of an acidic effluent from the proposed waste rock facility. The expected pore water volume in the proposed Clydesdale Waste Rock Facility would be around 2 to 3 percent (Schafer 2008a) and would remain below the amount needed to initiate seepage from the facility. In addition, the PAG cells in the proposed Clydesdale Waste Rock Facility would have a cover of 24 inches of topsoil and 48 inches of Carlin material, with a 50-foot setback from the base of the facility. Groundwater beneath the facility would be approximately 150 feet below ground surface after recovery of the groundwater table following cessation of mining. This design should prevent seepage from the facility under all expected precipitation scenarios for the life of the facility. No impacts to groundwater are expected from the proposed facility. Should seepage occur

from the Clydesdale Waste Rock Facility under prolonged adverse weather conditions, the water quality in the seepage is expected to be elevated in sulfate, fluoride, arsenic, cadmium, nickel, and manganese (Schafer 2008b).

The quality of the water that may seep from the proposed Clydesdale Waste Rock Facility under conditions of extreme precipitation would depend on the path of the infiltrating water through the waste rock and the chemical reactions that may ensue. If calcite is involved in the reactions between infiltrating water and waste rock, any fluid that may emanate from the base of the Clydesdale Waste Rock Facility would have a neutral pH; sulfate in the range of 2,600 mg/L; fluoride around 2 to 3 mg/L; manganese around 5 mg/L; nickel around 6 mg/L; and elevated arsenic (1.15 mg/L); cadmium (0.2 mg/L); copper (0.3 mg/L); and antimony (0.074 mg/L). It is unlikely that seepage would ever emanate from the proposed Clydesdale Waste Rock Facility because of the design of the infiltration barrier in the cover.

Goldstrike No. 3 Tailings Facility

The proposed Goldstrike No. 3 Tailings Facility is designed to be a zero-discharge facility, thus eliminating the potential for seepage of effluent that may be acidic or elevated in metals. The facility would contain approximately 115.4 million tons of tailings and have a composite liner along with a drain beneath the tailings liner to capture any seepage and an underdrain beneath the facility to allow for passage of stream waters. Thus, no impacts to groundwater are expected from this proposed facility.

The proposed Goldstrike No. 3 Tailings Facility would have thickened tailings with about 50 to 60 percent solids and an internal drain system above the double liner to allow for removal of water to reduce the hydraulic head on the liner. At closure, the tailings would be reclaimed with an infiltration cover to prevent entry of precipitation and would be drained to remove the readily drainable water using the drains installed above the double liner. Draindown time is estimated to take about 50 years for the draindown rate to decline to a steady value around 9 gpm (see **Figure 2-20**). During the first 10 years of draindown, the tailings would drain at a rapidly declining rate between about 100 to 200 gpm initially and 50 gpm at 10 years. Then the draindown rate would decline slowly to reach the rate of about 9 gpm at 50 years after closure (see **Figure 2-20**). The water quality in the draindown fluid is expected to be similar to that of the AA Tailings and the North Block Tailings and consist of sulfate, sodium, bicarbonate, calcium, and various metals. The water would be sodium sulfate dominated water with a TDS around 3,000 to 5,000 mg/L and may be elevated in arsenic, fluoride, boron, copper, iron, and molybdenum (Schafer 2008b). This water would be managed with evaporation ponds to capture the draindown water and to prevent interaction with surface water or groundwater.

If the proposed Goldstrike No. 3 Tailings Facility were to leak water to the surface due to some unforeseen failure of either the underdrain seepage capture system or the tailings dam, the expected water quality would be similar to what is observed for the North Block Tailings and the AA Tailings draindown waters (Schafer 2008b). These waters have a pH around 7 to 8 standard units; TDS in the range of 3,000 to 5,000 mg/L; sulfate in the range of 2,000 to 3,300 mg/L; and sodium in the range of 360 to 740 mg/L; making the waters sodium sulfate dominated. Elevated metals include arsenic (0.05 to 1.2 mg/L), boron (0.08 to 0.4 mg/L), antimony (up to 0.01 mg/L), iron (1.5 to 2.5 mg/L), copper (0.1 to 0.3 mg/L), manganese (1.7 to 7.3 mg/L), thiocyanate (up to 27 mg/L), and molybdenum (0.4 to 2.1 mg/L).

3.3.2.3 Bazza Waste Rock Facility Alternative

Under this alternative, groundwater resource impacts would be the same as described for the Proposed Action. PAG and non-PAG waste rock would be encapsulated in the existing Bazza Waste Rock Facility according to the approved Bazza Waste Rock Management Plan. No impacts to groundwater are expected from continued use of the Bazza Waste Rock Facility.

3.3.3 Cumulative Groundwater Effects

3.3.3.1 No Action Alternative

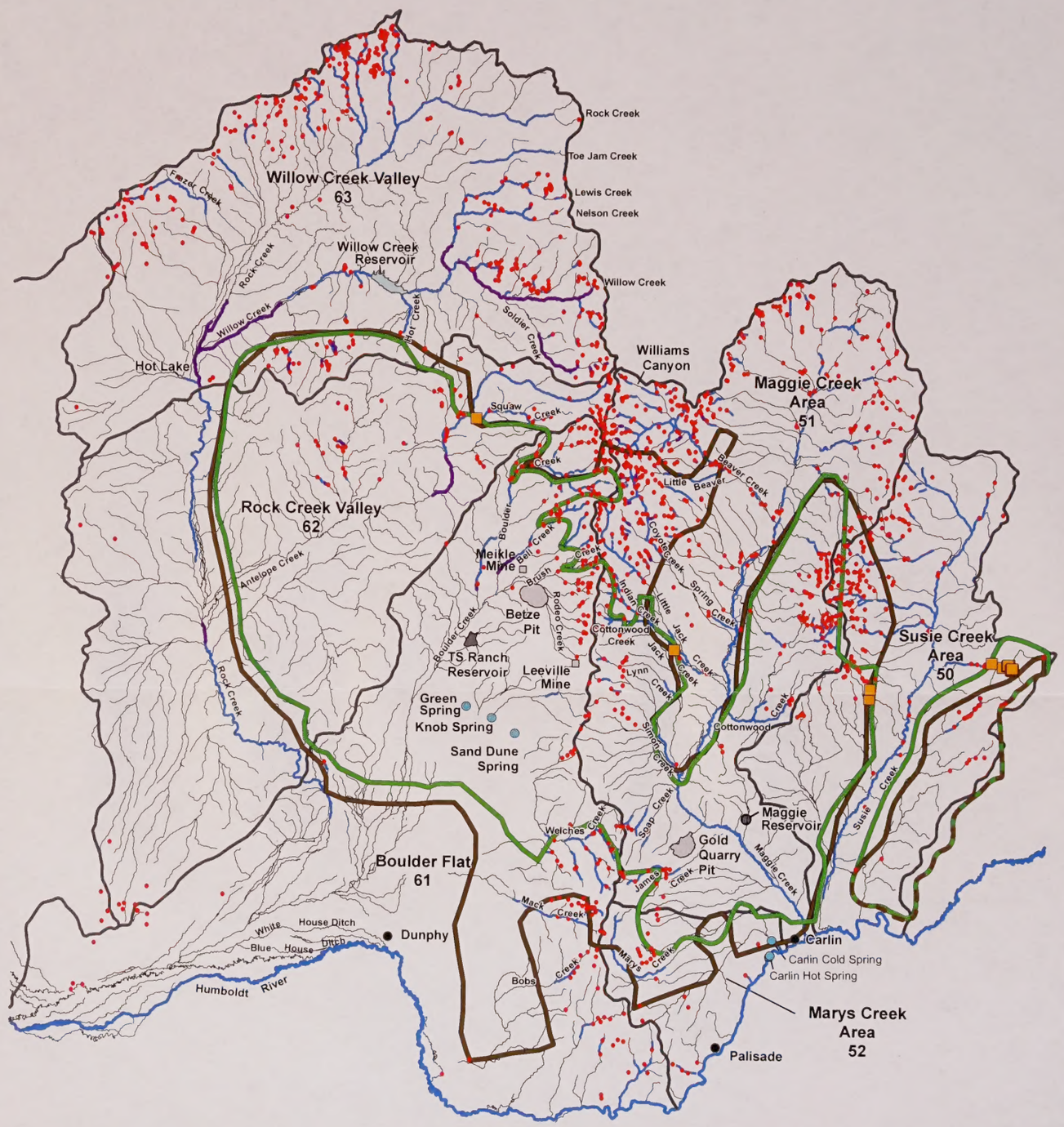
The CESA for groundwater resources encompasses six hydrographic basins along the Carlin Trend that lie north of the Humboldt River, as shown in **Figure 3.3-1**. These basins include Susie Creek (Hydrographic Basin 50), Maggie Creek (Hydrographic Basin 51), Marys Creek (Hydrographic Basin 52), Boulder Flat (Hydrographic Basin 61), Rock Creek (Hydrographic Basin 62), and Willow Creek (Hydrographic Basin 63).

The CESA for groundwater is the same as the area evaluated in the BLM's April 2000 CIA report (BLM 2000b). For that assessment, mine discharges were evaluated from the SOAPA, Betze/Post, Leeville, and Lone Tree mines. The Lone Tree Mine ceased dewatering activities in 2006. This cumulative effects analysis will consider only the Betze/Post, Leeville, and SOAPA dewatering and water management activities and will tier off the BLM (2000b) CIA report. The past and present actions and RFFAs in this area are identified in Section 3.1.

Figure 3.3-48 compares the estimated maximum projected extent of the cumulative 10-foot drawdown from the 2000 SEIS (BLM 2000a, 2003a) and the current 2007 estimate of this same cumulative 10-foot drawdown using the current versions of the BGMI and Newmont groundwater models. Compared to the 2000 EIS maximum cumulative 10-foot drawdown, the 2007 drawdown is somewhat less in the southern Tuscarora Mountains and somewhat greater in the Susie Creek area (**Figure 3.3-48**). The figure shows that there are no new cumulative impacts that were not already considered in the 2003 SEIS for the Betze Project (BLM 2003a) with the following exception. Using the 2007 models, there are 14 springs that fall outside the original 2000 SEIS estimate of the maximum predicted cumulative 10-foot drawdown in the uppermost aquifer but fall within the 2007 estimate of this same maximum cumulative 10-foot drawdown in the uppermost aquifer. These 14 springs are shown on **Figure 3.3-48**. Two of these springs are within the predicted maximum 10-foot drawdown due to pumping from the Betze Pit. The others are in the Susie Creek area and are related to pumping at Gold Quarry. The two springs that fall within the predicted maximum cumulative 10-foot drawdown contour that may be related to pumping at Betze fall only slightly outside the original 2000 maximum cumulative 10-foot drawdown contour. One spring is in Jack Creek and is located above an elevation of 6,000 feet amsl, suggesting it may not be affected by groundwater pumping. The other spring is in Squaw Creek and is located very close to the original 2000 SEIS maximum cumulative 10-foot contour. Potential impacts to these two springs would be of unknown extent but would be of relatively short-term duration because the springs are at the maximum extent of the 10-foot drawdown contour. The Betze Project Final SEIS (BLM 2003a) has a contingency fund for unexpected impacts, and these two springs would be covered by that special fund (see Section 3.3.4.2, Mitigation Measures).

Impacts to groundwater quality are not expected from cumulative drawdown throughout the CESA. Bedrock water quality is elevated above Nevada drinking water standards for arsenic (BLM 2000a) in some areas due to naturally elevated arsenic in the bedrock. Water quality in bedrock is relatively similar throughout each hydrographic basin in the CESA, so that temporary changes in groundwater flow paths due to cumulative mine-induced drawdown are not expected to result in measurable changes in water quality.

Runoff and drainage from waste rock storage facilities, leach pads, tailings impoundments and other mine-related facilities could potentially impact water quality. To date, with the exception of the Hollister Development Block Project in the Antelope Creek drainage, there has been no indication of ARD or elevated metals in groundwater related to mining in the CESA (BLM 2007b). The South overburden stockpile at Hollister has generated acidic drainage in the past, but the conditions that caused the acidic drainage have been corrected (BLM 2007b). ARD has occurred at refractory ore piles at Newmont's South Operations Area; this drainage is captured and used in ore processing. These stockpiles will be removed prior to project closure and, therefore, would not present a long-term concern for water quality. Impacts to surface water quality and possibly groundwater quality also can be related to non-mining processes such as wildfires, flooding, and erosion.



3.3-63

Figure 3.3-48

Potentially Impacted Springs within the Cumulative Drawdown Area

Betze Pit Expansion Project

LEGEND

- Maximum Extent of Cumulative 10-foot Drawdown Contour (2007 Model)
- Maximum Extent of Cumulative 10-foot Drawdown Contour (2000 Model)
- Groundwater Basin Boundary
- Stream (Intermittent or Ephemeral)
- Perennial Stream Reach
- Discontinous Flowing Stream Reach
- Seeps and Springs
- Seeps and Springs that are within the 2007 Cumulative Drawdown Contour but not within the 2000 Cumulative Drawdown Contour

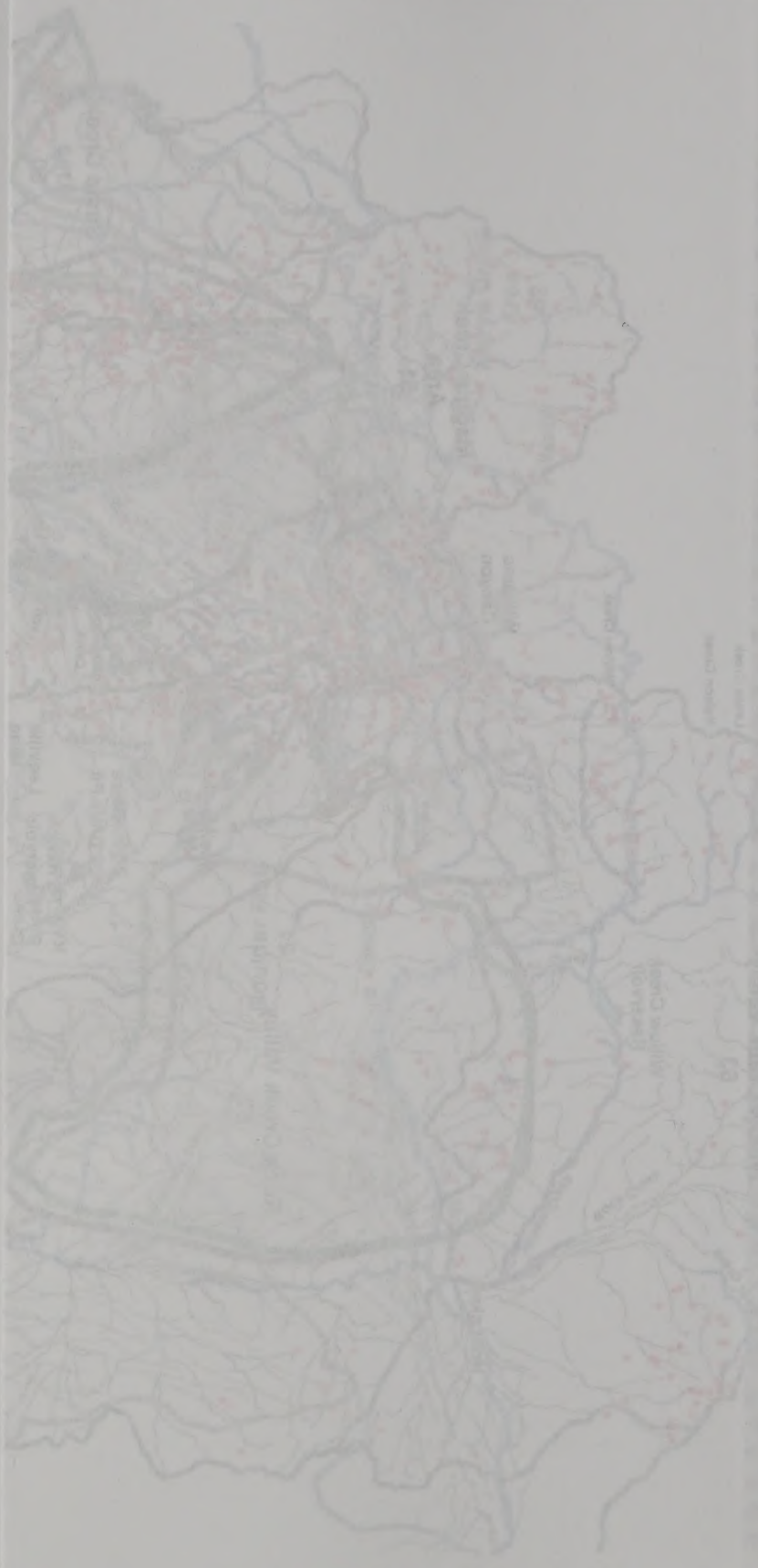
Note: Stream locations are taken from USGS line graph database. Hydrographic Area Boundary locations are approximate.

Source: BLM 2000b; BGMI 2007a.

N

0 5 10 Miles

07/22/2008



In 1994, a small seep was discovered west of the active mining area near Goldstrike. This seep had a low pH, and a collection pond was constructed to capture the seep water and transfer the water to the Goldstrike processing facility. The seep was the result of a pipeline leak, and the problem was repaired. The pipeline was in an area where the original ground surface contacted historical waste rock from previous operations. This waste rock was excavated during subsequent laybacks of the Betze Pit. In 2006, a seep was detected downgradient of the Goldbug Refractory Ore Stockpile. The stockpile was excavated, and a flaw was discovered in the soil liner due to settling of the foundation material below. The source of the low pH seep was removed and disposed of in a contained process facility. In 2007, a seep was detected on the BLLS-50 Stockpile. The stockpile was excavated, and all ore and impacted subsurface material were removed to a contained facility (BGMI 2008a). There was no impact from these events and no expectation that future activities will affect groundwater quality.

At the end of mining in the CESA, there would be pit lakes. The Betze Pit lake was discussed earlier in detail and is not expected to result in a long-term impact to water quality. This pit lake would be a terminal pit lake with elevated sulfate and TDS. Similarly, the Tara Pit north of Goldstrike would be a terminal pit lake and would have a near-neutral pH with an arsenic concentration below influent groundwater quality and an antimony concentration within Nevada drinking water standards (BLM 2007b). Water in these pit lakes would not be used for human consumption or recreation. The Gold Quarry Pit lake would be a flow-through pit lake starting at 70 percent recovery. Pit lake outflow would reach a maximum of about 1,440 gpm at 100 percent recovery. Pit outflow would be to the southeast following the groundwater gradients in the area of the pit and the water quality of the pit outflow would be similar to or better than background water quality (Geomega 2001).

Figure 3.3-48 shows the cumulative drawdown area based on the BGMI modeling, which includes Newmont dewatering as well as the BGMI mine dewatering operations. Newmont also has modeled a cumulative drawdown area based on combined BGMI and Newmont mine dewatering operations. Their modeled area of drawdown is presented in Figure 3.2 of the Leeville and SOAPA Draft Supplemental Environmental Impact Statements (BLM 2007b,c). As expected, there are differences between the models. However, the Newmont-calculated cumulative drawdown area is entirely within the BGMI-calculated drawdown area. Thus, potential impacts represented in the cumulative drawdown area are addressed within the more conservative BGMI model.

3.3.3.2 Proposed Action

Cumulative effects under the Proposed Action would be similar to the No Action Alternative in terms of groundwater quantity and quality. Under the Proposed Action, the Betze Pit lake would have a slightly altered chemistry due to the quantity of waste rock placed in the pit.

3.3.3.3 Bazza Waste Rock Facility

Cumulative effects under this alternative would be similar to the Proposed Action.

3.3.4 Mitigation Measures and Monitoring

3.3.4.1 Existing Monitoring Plans and Programs

The following ongoing water monitoring programs or plans are designed to monitor surface and groundwater activities and potential impacts in the CESA:

1. Boulder Valley Monitoring Plan (BVMP): Since 1990, BGMI has conducted monthly monitoring and semi-annual reporting of surface water and groundwater resources in Boulder Valley and the Boulder Flat Hydrographic Basin related to mine dewatering and water management activities. Surface monitoring stations are located on Bell, Brush, Rodeo, and Rock creeks. Groundwater wells and

springs are monitored for water levels, flow rates in springs, and water quality. Surface water sites are monitored for water flow rates and water quality.

2. Seep and Spring Survey by BGMI: BGMI conducts annual seep and spring monitoring for water quality, flow rates, and vegetation at up to 36 sites in the Tuscarora Mountains.

3. Maggie Creek Basin Monitoring Plan (MCBMP): Newmont began this program of monthly monitoring and semi-annual reporting of surface water and groundwater in the Maggie Creek Basin in 1989. The MCBMP monitors surface water flow, depth to groundwater in wells, surface water quality, groundwater quality, and both spring flow and water quality in the Maggie Creek, Marys Creek, Susie Creek, and the southeast portion of Boulder Flat hydrographic basins. This monitoring plan is designed to monitor potential impacts from mine dewatering and water management activities at Newmont's Gold Quarry and Leeville mines.

4. Leeville Hydrologic Monitoring Plan: Newmont began reporting the results of ongoing monitoring of water resources in the vicinity of the Leeville Mine in 2003. Results of this monitoring plan are included in the MCBMP monitoring reports.

5. Seep and Spring Survey by Newmont: Since 1990, Newmont has been monitoring seeps and springs in the four hydrograhic basins near Gold Quarry that are part of the MCBMP. A total of 33 springs are monitored annually in the fall. Monitoring consists of measuring flow rates, water quality, and general site conditions.

6. The BLM Elko District Office has conducted lentic (springs, seeps, and ponds) and lotic (streams) assessments at selected grazing allotments in the Carlin Trend and surrounding areas. These assessments address the effects of livestock grazing on springs, seeps, ponds, and streams.

All water resources monitoring data and reports are made available on a semi-annual basis by BGMI and Newmont to the BLM, NDEP, and NDWR. These monitoring plans and programs would remain in effect until modified or cancelled by regulatory agencies and would provide the basis for assessing potential impacts to water resources. A pit lake monitoring plan will be prescribed in the final permanent closure plan and closure permit. This will be submitted to NDEP 2 years preceding cessation of mining operations. No additional monitoring is recommended beyond the current committed monitoring.

3.3.4.2 Mitigation Measures

No additional mitigation is recommended beyond the current committed mitigation measures for all water resources that fall within the original 2000 EIS (BLM 2000a, 2003a) maximum predicted cumulative 10-foot drawdown in the uppermost aquifer (**Figures 3.3-27** and **3.3-48**). For those few springs that fall outside this original estimate of the maximum cumulative 10-foot drawdown but within the revised 2007 estimate of the maximum cumulative 10-foot drawdown in the uppermost aquifer (**Figure 3.3-48**), the mitigation and monitoring measures outlined in the Betze Project SEIS (BLM 2003a) also would apply. The existing Long-term Monitoring and Mitigation Trust Fund (see Section 2.2.1.13, Applicant-committed Environmental Protection Measures) would provide mitigation for unanticipated impacts.

3.3.5 Residual Impacts

No residual impacts would occur to groundwater resources under the Proposed Action. For the No Action Alternative, residual unavoidable adverse effects to groundwater resources would remain after full recovery of groundwater levels in the post-mining period. These impacts would include: the long-term residual drawdown in groundwater levels due to evaporation from the Betze Pit lake; reduction in baseflow to some streams due to permanent lowering of groundwater levels; and reduction in flow rates at some seeps and springs within the long-term residual groundwater drawdown cone.

3.4 Surface Water Resources

The surface water assessment focuses on two study areas: the immediate project area related to the Proposed Action and alternatives; and the encompassing CESA, in which the potential cumulative impacts of mining, mine dewatering, and other activities are examined.

The existing facilities and proposed disturbance are shown in **Figures 2-1** and **2-11**. As shown in **Figure 3.3-1**, the water resources CESA includes six groundwater basins designated by the NDWR. The CESA occupies approximately 2,073 square miles (NDWR 2005). The basin boundaries generally correspond to topographic divides, and they all drain southward to the Humboldt River. Elevations within the CESA range from approximately 8,800 feet in the Tuscarora Mountains to 4,500 feet on the Humboldt River near the Town of Battle Mountain.

3.4.1 Affected Environment

3.4.1.1 Hydrometeorology

The hydrometeorological setting of the region has been described in some detail in previous environmental documents for the area (BLM 2000a,b).

Average annual precipitation varies widely within the region but generally increases with elevation. Most precipitation falls as snow in the mountains during winter and spring. Total annual precipitation averages less than 10 inches on Boulder Flat and generally ranges from 14 to 20 inches at higher elevations in the Tuscarora Mountains (U.S. Department of Agriculture Natural Resources Conservation Service [USDA-NRCS] 1998). Since 1993, the mean annual total precipitation at the Goldstrike Mine has been 11.4 inches (Cedar Creek Associates 2007a). Average monthly precipitation values for approximately 60 years of record at Elko and Battle Mountain are shown in **Table 3.4-1**. Total annual precipitation has averaged 9.7 inches at Elko and 8.0 inches at Battle Mountain for the period 1950 through 2006. Free water surface evaporation, which approximates the losses that may occur from a shallow lake, is approximately 44 inches per year in the region overall. Based on measurements since 1991 at the Goldstrike Mine, the free water surface evaporation there is approximately 36 inches per year. Overall, the vast majority of precipitation (up to 90 percent) is consumed by evapotranspiration (McDonald Morrissey Associates, Inc. 1996b).

Table 3.4-1 Average Monthly Precipitation (in inches) at Elko and Battle Mountain, 1950 - 2006

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Elko	1.19	0.82	0.94	0.87	1.01	0.76	0.40	0.48	0.54	0.64	1.00	1.09	9.71
Battle Mountain	0.79	0.64	0.69	0.90	1.07	0.85	0.27	0.32	0.52	0.59	0.67	0.78	7.96

Precipitation and resulting runoff vary widely between years and locations in the Basin and Range Province. As an example, **Figure 3.4-1** indicates the wide variation in total annual precipitation at the Elko and Battle Mountain meteorological stations. Periodic droughts can be seen in the 1950s, mid-1970s, late 1980s, early 1990s, and to some degree from 1999 through 2002. Generally, the years after 2002 have been wetter than average. In keeping with regional variability, annual precipitation at the BGMI operations totaled approximately 5 inches in 2001 and 21 inches in 2005.

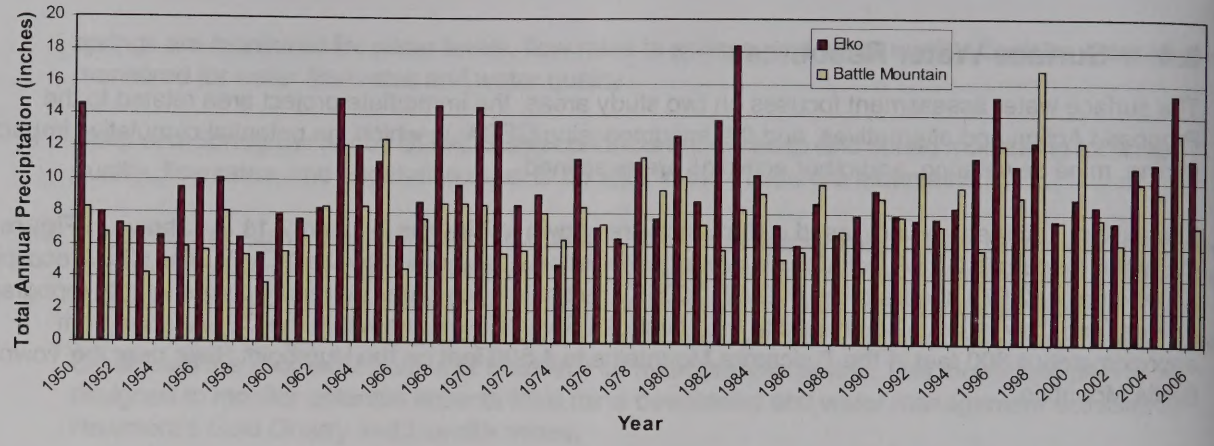


Figure 3.4-1 Variation in Annual Precipitation at Elko and Battle Mountain

3.4.1.2 Surface Water Flow and Channel Characteristics

A number of drainages occur in the study area (**Figure 3.3-1**), and their streams all flow toward the Humboldt River. On the eastern side of the Tuscarora Mountains, Marys Creek, Maggie Creek, and Susie Creek are major tributaries to the Humboldt River. These three drainages have been investigated by Newmont Gold Company (1991); Maurer et al. (1996); Zimmerman (1992); and the USGS (Prudic et al. 2006). Maggie Creek and Susie Creek exhibit perennial flows over most of their lengths.

On the western side of the Tuscarora Mountains, Rock Creek forms the major surface water network tributary to the Humboldt River. Rock Creek has both intermittent and perennial reaches interspersed along its length. The channel traverses the southwest portion of Boulder Flat and receives flow from Blue House Slough as well as from the Boulder Creek - White House Ditch - Blue House Ditch system before it joins the Humboldt River near Battle Mountain (**Figure 3.3-1**). Willow Creek and Antelope Creek are major tributaries to Rock Creek to the north and west of BGMI's operations, and Boulder Creek the major stream through Boulder Valley from the north. Rodeo Creek, Bell Creek, and Brush Creek, which pass through the project area, are tributaries to Boulder Creek. These drainages and their watershed characteristics were described previously in the Betze Project Draft EIS and subsequent SEIS (BLM 1991a, 2000a, 2003a).

Surface water flows in the CESA originate from snowmelt, infrequent rainfall events, and groundwater discharges through the stream channel or from seeps and springs. Large flow rates may occur in the winter or early spring as a result of rain on snow or frozen ground, but more commonly the annual high-flow events occur from snowmelt in the spring. Occasionally, isolated flooding may result from intense local thunderstorms, which most often occur from late spring through the fall. The seasonal duration of stream flow has been identified through field surveys for streams in the CESA. These are shown for stream reaches in **Figure 3.3-1**. Flow occurrence in tributary reaches is typically either ephemeral or intermittent. Perennial reaches occur along tributary streams draining the Tuscarora Mountains and elsewhere, as indicated in **Figure 3.3-1**.

3.4.1.3 Mine Water Management

In its upper reaches, Rodeo Creek is an ephemeral channel that was diverted in the mine area by Newmont in 1990 with approvals from the State of Nevada. Flows from catchments upstream of BGMI's property on Rodeo Creek are attenuated by the Rodeo Creek Diversion Dam, which consists of an earthen dam with an ungated 66-inch-diameter reinforced concrete pipe (RCP) outlet. **Figure 2-4** shows the Rodeo Creek Diversion closure options in the pit area. The Brush Creek diversion re-routes flows from Brush Creek to Rodeo Creek just downstream of the Rodeo Creek Diversion Dam.

The recently completed Brush Creek diversion was designed and constructed to adequately convey runoff from a 100-year/24-hour storm event. It contains concrete or rip-rap reinforced sections and grade controls as needed. The diversion has a flatter gradient and greater length than the native ephemeral channels it replaces. Since the diversion may accumulate sediment, BGMI conducts periodic inspections and performs maintenance as needed to maintain the channel structure and its flow capacity.

During final reclamation and closure activities BGMI would control run-on onto project components from the Brush Creek system in accordance with NDEP regulations (NAC 519A-345) and closure guidance (NDEP-BMRR 2000). At that time, separate reinforced channels may be configured to control runoff through the property. Proposed channel designs would be submitted to NDEP, and constructed as determined through the agency review process. Drainage controls would be designed and constructed for the long-term, and would be inspected for performance during the required post-reclamation and closure monitoring period.

Other existing water management features that involve surface water resources have been described in previous assessments for the BGMI project area and the CESA (BLM 2000a,b). These features are summarized in Section 2.2.1.12, Water Management Operations. Briefly, they consist of flow routing, detention, and water application features such as the Boulder Valley Canal, TS Ranch Reservoir, embankments to control springflows, and a number of center pivot or flood-irrigated fields. Pumped groundwater that is not used in mining, processing, or irrigation is infiltrated/injected through TS Ranch Reservoir infiltration ponds, injection wells, or discharged to the Humboldt River through an approved outfall in lower Boulder Valley. These features are generally depicted in **Figure 2-3**.

During the past few years, mine dewatering rates have decreased steadily. An average pumping rate of about 38,000 gpm (about 85 cfs) occurred in the year 2000; about 25,000 gpm was the average pumping in the year 2003. During late 2006 and early 2007, mine dewatering by BGMI averaged 18,136 gpm (40.4 cfs, or about 29,300 acre-feet per year) (BGMI 2007a). Beginning in August 2003, the Boulder Valley water management system began receiving excess mine water from the Newmont Leeville operations. Center pivot irrigation at TS Ranch was conducted in October 2006, and pond infiltration occurred between November 2006 and February 2007. The water treatment plant did not operate during late 2006 and early 2007, and no water was discharged to the Humboldt River during that time. BGMI has an existing permit to discharge to the Humboldt River, but has not done so since February 1999 and is not proposing to do so under any alternative considered in this analysis.

3.4.1.4 Boulder Valley Surface Water Monitoring

Before mine dewatering activities, flow data for selected Boulder Valley streams were collected and were available for the Betze Project EIS (BLM 1991a,b). These baseline data indicate that the upper third of Rodeo Creek was ephemeral, but downstream reaches were perennial or intermittent. Bell Creek was perennial in its headwater reaches, but it became intermittent with perennial pools nearer its confluence with Rodeo Creek. Brush Creek was perennial in its headwaters and middle reach, but it was ephemeral downstream near Rodeo Creek. Boulder Creek was perennial in its upper headwater reaches, primarily because of springflows. Boulder Creek became ephemeral near Rodeo Creek and downstream (BLM 1991a,b).

As discussed in Section 3.3.1, BGMI has conducted water resources monitoring in Boulder Valley since 1990. Quarterly or semi-annual monitoring reports have been submitted to the state since 1991. Newmont monitors water resources in the eastern part of the CESA and in the vicinity of its Leeville Project. Locations of current surface water monitoring locations in Boulder Valley and the CESA are shown in **Figure 3.4-2**. In addition, both BGMI and Newmont conduct spring and seep monitoring within the CESA. The Elko District Office of the BLM also has conducted spring, seep, and stream assessments in the area, focusing on effects from grazing.

Descriptions of stream flows in the CESA prior to 1999 are presented in earlier NEPA documents (BLM 2000a,b). Based on data collected in the mine area since 1999, Rodeo Creek in its uppermost reaches (Station RC-AA; **Figure 3.4-2**) appears to be an ephemeral stream that may exhibit more intermittent flows farther downstream at Station RC-A (BGMI 2007f). Intermittent flows in the spring at Station RC-A ranged from

approximately 200 to approximately 700 gpm (approximately 0.4 to 1.5 cfs) during 2004 through 2006. Downstream at Station RC-B, Rodeo Creek is an intermittent stream with substantially larger discharge magnitudes as a result of Brush Creek additions and other contributing tributaries. Flows of approximately 1,700 and 2,500 gpm (3.8 and 5.6 cfs) occurred at Station RC-B in the springtime of 2005 and 2006, respectively. Measured flows also increased substantially between Station RC-B and the farthest downstream monitoring location, Station RC-C, largely due to contributions from Bell Creek and other tributaries. Some flow losses occur on the alluvial fan system between Bell Creek at BL-1 and Rodeo Creek RC-C.

Since 1999, Bell Creek appears to generally lose flow to the valley alluvium along its length between Stations BL-2 (upstream at the valley head) and BL-1 (downstream on the fan system). This trend is somewhat inconsistent, however, with larger flow rates at BL-1 on occasion (BGMI 2007f). Variable snowmelt and/or discharges from springs may account for these differences. Since the year 2000, Brush Creek has consistently lost slight amounts of flow in a downstream direction from Station BR-1 to BR-2 (**Figure 3.4-2**).

Years of lower precipitation between approximately 1999 and 2002 are reflected in reduced streamflows on Bell Creek, Brush Creek, and lower Rodeo Creek. In general, flows in these streams tended to increase again during and after 2004 (BGMI 2007f). A similar pattern occurred on uppermost Antelope Creek at Station ANT-1A. However, downstream at ANT-1 and other stations, Antelope Creek loses flow to the valley alluvium. Based on additional data collected since 1999, Antelope Creek is intermittent or exhibits discontinuous pools as it crosses the valley alluvium.

Upstream of the Sheep Creek Range, Rock Creek flows were relatively consistent between 1999 and early 2007. These flows were substantially reduced from those occurring between 1996 and 1998. It appears that total annual precipitation may not correlate well with upper Rock Creek flows. Rock Creek gains substantial flow as it passes through the Sheep Creek Range. Just upstream of the Sheep Creek Range, Rock Creek at Station RKC-3 (**Figure 3.4-2**) has shown variable flow seasonality since 1999; downstream at Station RKC-4, it has been perennial. Immediately downstream of the Sheep Creek Range, flows in Rock Creek increased during 2004 and after, lagging behind precipitation increases. Except for this short reach downstream of the Sheep Creek Range, Rock Creek often goes dry in Boulder Valley.

Since the early 1990s, data for Boulder Creek indicate that it is intermittent in its upper reaches (at Stations BC-AA, BC-A, and BC-B) and probably ephemeral at BC-C and downstream until it terminates at Boulder Flat. The stream typically goes dry in late summer and fall. In general, flow rates decreased after 1999. Flow gains and losses are inconsistent along the channel length. Flows in lower Boulder Creek may be affected by seepage contributed by irrigation.

3.4.1.5 Surface Water Rights

Past inventories of surface water rights and applications for surface water rights provided information on locations and status within the hydrologic study area. This information was presented in previous NEPA documentation for the project area and the CESA (BLM 2000a,b). The primary uses for the water are stock watering, municipal uses, irrigation, and domestic uses.

3.4.1.6 Surface Water Quality

Surface water quality standards are established by the State of Nevada to protect waters of the state. Many standards are developed for specific designated beneficial uses, as defined in NAC 445A.122. Applicable water quality standards are prescribed in NAC 445A.144 (standards for toxic materials applicable to designated waters) and in NAC 445A.121 through 445A.127, inclusive. Relevant standards also were discussed extensively in previous NEPA documentation for the project area and the CESA (BLM 2000a,b).



3.4-5

Betze Pit Expansion Project

Figure 3.4-2

Current Surface Water Monitoring Locations in the Cumulative Effects Study Area

LEGEND

- Newmont Surface Water Monitoring Site
- BGMI Surface Water Monitoring Site
- Groundwater Basin Boundary
- Stream (Intermittent or Ephemeral)
- Perennial Stream Reach

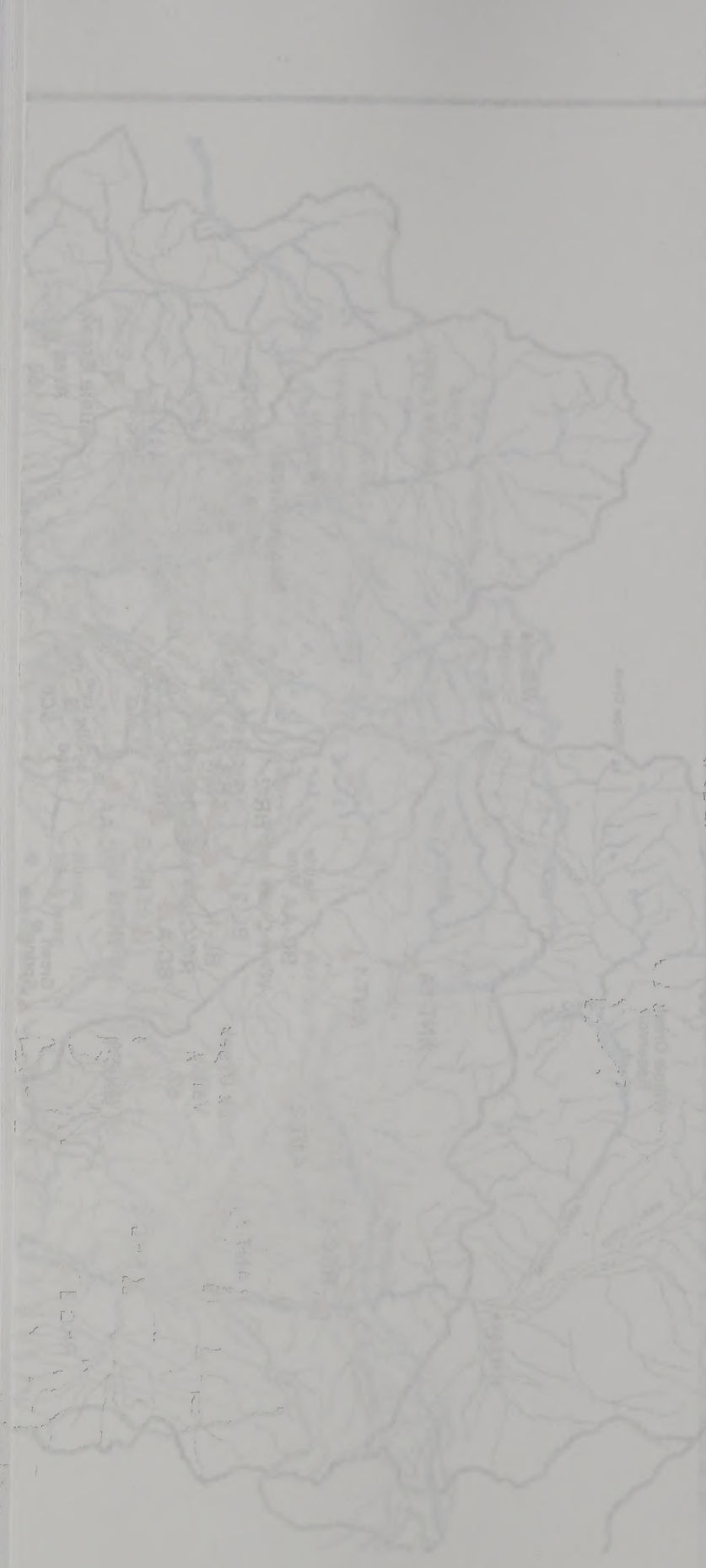
N

0 5 10 Miles

Note: Stream locations are taken from USGS line graph database. Hydrographic Area Boundary locations are approximate.

Source: Newmont 2007; BGMI 2007f.

05/20/2008



Stream water quality within the hydrologic study area is monitored by BGMI on a monthly basis and reported semi-annually. The following basins and their streams are monitored (**Figure 3.4-2**) (BGMI 2007f):

- Boulder Flat: Bell Creek, Boulder Creek, Brush Creek, Rodeo Creek; and
- Rock Creek Valley: Antelope Creek, Rock Creek.

Surface water samples are dominated by calcium, magnesium, and sodium cations, and bicarbonate was the dominant anion (BGMI 1999). Total dissolved solids concentrations ranged from 106 mg/L in middle Boulder Creek at Station BC-B to 519 mg/L in Rodeo Creek at Station RC-A (**Figure 3.4-2**). Values of pH were typically neutral to alkaline, ranging from a low of 7.08 standard units in Boulder Creek at Station BC-B to 8.9 standard units in Rock Creek at Station RKC-2.

Metals concentrations were typically below applicable Nevada water quality standards, but there were incidences of elevated total arsenic on Rodeo Creek upstream of the mine. Total arsenic concentrations were 200 micrograms per liter (µg/L) at Station RC-AA and 123 µg/L at Station RC-A. The current Nevada drinking water standard for total arsenic is 50 µg/L; 100 µg/L for irrigation use, and 200 µg/L for livestock watering. The fourth quarter 2006/first quarter 2007 monitoring report indicates that water quality standards were met elsewhere for other constituents (BGMI 2007f).

3.4.2 Environmental Consequences

The primary issues related to surface water resources include:

- Reduction in surface water quantity through 2015 (No Action Alternative);
- Impacts to surface water quality from the construction, operation, and closure of tailings facilities, waste rock facilities, surface water diversions, and other mining and processing facilities; and
- Impacts from flooding, erosion, and sedimentation associated with mine construction, operation, and closure activities.

3.4.2.1 No Action Alternative

Under the No Action Alternative, groundwater pumping will continue through 2015. This would reduce streamflows in the vicinity of the Betze Pit and in some outlying areas for an extended period of time. Reduced streamflows would be most noticeable along perennial and intermittent stream reaches near the Betze Pit and Bazza Waste Rock Facility. Part of the flow in these streams is contributed by groundwater seeping into the channels over time ("baseflow"). These long-term baseflows create perennial and intermittent streams in the study area.

Extending the period of groundwater pumping would reduce baseflows for a greater length of time. This would continue to shorten the seasonal duration of streamflows as well as reduce flow rates. The locations and magnitudes of these effects were assessed previously (BLM 2000a,b), and are expected to be similar under the No Action Alternative. The affected areas anticipated within the 10-foot groundwater drawdown area are similar to previous assessments (BLM 2000a,b; Zhan 2007). These areas are shown in **Figure 3.3-26**.

In general, the areas where streamflows could be reduced include a portion of Antelope Creek just upstream of the valley alluvium, upper Boulder Creek, and upper Brush, Bell, and Rodeo creeks, as described for the No Action Alternative in the groundwater discussion. Potential impacts to springs, which are closely tied to stream baseflows, also are part of that discussion (see Section 3.3.2.1, No Action Alternative, Comparison of 2000 and 2007 Groundwater Models).

Part of Rodeo Creek will be diverted southward around the Betze Pit to expand mining of the pit to the northwest under current NDEP authorizations (Permit # TNEV 2008309, Appendix A). A total of 28.1 acres of

disturbance will occur as a result of the planned and authorized diversion of Rodeo Creek around the south end of the Betze Pit. The Rodeo Creek Diversion will route flows from upstream catchments around the Betze Pit and back into the original channel downstream of the pit. This diversion is further discussed in Section 2.3.6. Routed flows return to Rodeo Creek west of the pit (**Figure 2-4**). Middle Rodeo Creek currently has an ephemeral flow regime, and this would continue with the diversion built under the No Action Alternative. Overall watershed areas contributing to the Boulder Valley stream system would remain the same.

No impacts to streamflow magnitudes or surface water quality in Rodeo Creek are anticipated as a result of the diversion. Ephemeral channel segments would be removed, but they would be replaced with lengths of diversion channel. The Rodeo Creek Diversion would roughly approximate the same length and gradient as the original channel. Long-term diversion designs and modifications for the Rodeo Creek Diversion will be completed, if necessary, during final reclamation and closure.

Under the No Action Alternative, Rodeo Creek and Brush Creek would continue to provide ephemeral streamflows to the valley fill system in the project area and downstream during active mining. These flows are typically lost to infiltration and evapotranspiration before they reach Boulder Creek, or shortly after. Water quality impacts on the Humboldt River are not anticipated because Boulder Creek is not a tributary to the Humboldt River.

Rodeo Creek was originally diverted in the early 1990s by Newmont. At the time, the channel traversed the current Betze Pit. The creek was subsequently diverted to the north, and has been stabilized by riprap, concrete grade controls, and geosynthetic clay linings at selected locations. The existing channel is essentially trapezoidal in section and does not support riparian vegetation.

At the end of mining as a closure option, Rodeo Creek may be diverted into the Betze Pit and the corresponding pit lake that would eventually form (Section 2.2.1.12). Streamflows from Brush Creek and upper Rodeo Creek would form part of the pit lake. Water quality in the pit lake is expected to improve as a result. The pit lake is discussed further in Section 3.3.2.2.

Based on data prior to mine dewatering, Rodeo Creek was perennial at Station RC-A (BLM 1991a,b). Streamflow durations were then intermittent at Station RC-B, and transitioned to ephemeral or weakly intermittent at Station RC-C (**Figure 3.4-2**). In its lower reach, Brush Creek was perennial and contributed substantially to peak flow rates at Stations RC-B and RC-C during the spring (BLM 1991a,b). In addition to other watershed characteristics, these flow regimes were likely related to the occurrence of geologic factors along the channels, such as faults, the occurrence of fractured or non-fractured bedrock, and seepage losses to the valley alluvium.

Mine dewatering impacts to Brush Creek flows and vegetation have occurred since 1993 and were documented in earlier NEPA assessments (BLM 2000b). Under current mine-water management, Brush Creek is an intermittent stream with a short perennial section in the uppermost portion of a central headwater tributary. Currently at Station RC-A and downstream, Rodeo Creek is weakly intermittent, flowing seasonally only in springtime during years of average or greater precipitation. It remains dry during below-average precipitation years, and is ephemeral upstream of RC-A (**Figure 3.4-2**).

In general, potential impacts to surface water quality during operations would be avoided by continuing compliance with existing NDEP permit approvals and operation of the mine water management infrastructure, as needed. As described in Section 2.2.1, Current Mining Operations or Facilities that Will Continue Unchanged, BGMI uses mine water in ore processing, dust control, and other mining or processing applications. In addition, excess water is discharged for agricultural applications and infiltration or injection. Treatment plants exist in these discharge circuits. No water has been discharged to the Humboldt River since February 1999. Although BGMI maintains its NDEP permit, it does not anticipate discharges to the river in the future.

BGMI operations have incorporated a SWPPP since 1994, and modifications and improvements have been implemented, as necessary. The principal storm water management practices are implemented, inspected, and maintained in accordance with Nevada General Discharge Permit NVR300000. Periodic evaluations have determined that the SWPPP is effective in controlling the discharge of pollutants from the property. Ongoing inspections and periodic improvements ensure that BGMI continues to comply with permit requirements as operations proceed (BGMI 2007d).

In addition to containment, staff training, and response procedures at equipment facilities or processing components, BGMI implements and maintains runoff and sediment controls along haul roads, at tailings facilities, and at waste rock disposal areas. These are particularly relevant to the project alternatives. Berms, ditches, sediment traps, detention ponds, and other BMPs are utilized and maintained at these components. Site inspections and periodic flyovers are made, and control measures are built, repaired, or modified as needed to maintain the effectiveness of the SWPPP.

As a result of implementing the SWPPP and complying with approved permits, little or no impact to surface water quality is anticipated during construction or operations associated with the No Action Alternative.

After mining ceases and post-mining drainage patterns are established, impacts to surface waters would occur from the mine closure option of diverting streamflows into the pit. These impacts would be minimal because in pre-existing conditions, most runoff in Rodeo Creek and Boulder Creek was lost to seepage and evapotranspiration in Boulder Valley. The overall loss of contributing watershed (24 square miles) in the Boulder Flat basin (560 square miles) represents approximately 4.3 percent of the larger basin. Since flows originating in the Rodeo Creek watershed rarely contribute to downstream flows, the re-routing of Rodeo Creek into the Betze Pit would not cause a substantial loss of surface water in Boulder Valley or the Humboldt River.

3.4.2.2 Proposed Action

Potential impacts to surface water resources associated with the Proposed Action include changes to:

- Channel extent and morphology; and
- Surface water quality.

Through existing project approvals by the State of Nevada, mine dewatering has been authorized through 2015. In addition, construction of the Brush Creek diversion has been reviewed and approved by the State. Construction of the Rodeo Creek Diversion south of the Betze Pit will be reviewed and approved by the State. Since the diversions are not located on federally administered lands, no BLM authorization is required.

As a mine closure option, Rodeo may be diverted into the pit (which may occur in both the Proposed Action and No Action alternatives as described in Section 2.2.1.12). Impacts to surface water resources from diverting Rodeo Creek into the Betze Pit at the end of mining would be similar to those described for surface water resources under the No Action Alternative described above. Some differences in pit lake water quality may result; these differences are described in Section 3.3.2.2.

Hydrologic investigations indicate that approximately 3,600 acre-feet of runoff would collect in the Betze Pit from a 100-year/24-hour storm occurring on the contributing 24-square-mile watershed if all of the rainfall was routed into the pit. In the long-term reclaimed condition, when the pit lake is at its anticipated steady state, over 100,000 acre-feet of flood storage would remain between the seasonal maximum pool elevation and the lowest crest of the pit wall. Under these conditions, pit outflows would not be expected from the storm events (BGMI 2007a).

Runoff water quality would be adversely affected by construction activities as new project facilities are built. Similar to the assessment for the No Action Alternative, impacts to surface water quality under the Proposed

Action would be avoided or minimized by implementing a revised project SWPPP and complying with the conditions of permit approval. Therefore, minimal impacts to surface water quality would occur during construction or operations associated with the Proposed Action. At most locations, implementation of runoff, erosion, and sedimentation BMPs would reduce these impacts to negligible levels.

During active mining and afterward, runoff from the proposed Clydesdale Waste Rock Facility and Goldstrike No. 3 Tailings Facility could be affected by geochemical constituents in the materials placed in those areas.

The proposed Clydesdale Waste Rock Facility closely borders both Rodeo Creek and its tributary Bell Creek. Potential impacts from the proposed waste rock facility and its associated haul road include:

- Channel disturbance, erosion, sedimentation, and stream geometry changes; and
- Degradation of surface water quality from waste rock and road runoff.

These impacts could occur either during construction, operations, or after mining and reclamation. Bell Creek, which closely borders the facility on the east, flows on an intermittent, seasonal basis. Flows from both Bell Creek and Rodeo Creek typically decrease in a downstream direction due to evapotranspiration and seepage into the valley fill. In addition, BGMI would construct the proposed waste rock facility with a 100-foot setback between the bottom of the slopes and the tops of the creek banks. These factors would avoid impacts to these surface water resources.

Haul road and culvert placement will disturb a portion of Bell Creek, a drainage deemed non-jurisdictional by the USACE (USACE 2006). Similar to the No Action Alternative, the implementation of runoff erosion and sedimentation controls as described in BGMI's current SWPPP would reduce the impact. The crossing would be designed to safely convey the 100-year/24-hour storm event. The approach and departure channel sections would be stabilized against potential scour. Sediment and runoff from the road and embankments could degrade water quality. The potential for this would be minimized by construction of 6- to 8-foot-high berms at the margins of the road, and by applying concurrent reclamation and erosion control practices. The berms would control drainage from the road surface, and other control practices, such as rock filters, erosion control blankets, or silt fences would minimize erosion and sedimentation from road and ditch features. If waste rock that has adverse geochemical characteristics is used for roadfill near the Bell Creek crossing, runoff water quality could be degraded. However, this impact would be avoided by construction procedures proposed by BGMI. PAG materials would not be used in haul road construction because of their low bearing strength and poor trafficability. Suitable haul road and embankment material is typically durable and calcareous. In addition, BGMI would test waste rock materials used for construction near drainages. Materials with adverse geochemical characteristics would not be used. BGMI would obtain and comply with a "Working in Waters" permit from NDEP Bureau of Water Pollution Control. This would promote careful construction and stabilization at creek crossings. As a result, minimal surface water impacts are anticipated.

The proximity of the Clydesdale Waste Rock Facility to both channels is likely to increase sediment loads and turbidity in streamflows. The steep topography of the adjacent waste rock slopes would accentuate storm and snowmelt runoff, with attendant erosion and sedimentation, into the creeks. Over the long term, these impacts are likely to occur even with BMPs and slope breaks implemented on the facility. More rapid runoff from waste rock slopes, even after reclamation, is likely to promote gullying along the channel banks bordering the facility. These effects would be adverse impacts along several miles of stream channels. To minimize these potential impacts, the toe of the Clydesdale Waste Rock Facility would be set back 100 feet from the tops of the banks along Bell Creek and Rodeo Creek.

Other potential impacts to surface water quality could be generated by the geochemistry of waste rock materials in the facility. Such impacts could include seepage containing acids or other water quality contaminants (e.g., elevated concentrations of metals or metalloids). These impacts would be minimized by the implementation of BGMI's Waste Rock Management Plan for the Clydesdale Waste Rock Facility (Schafer and Geosystems Analysis 2004) as follows:

- Isolation of potentially acid-generating materials at depths within the Clydesdale Waste Rock Facility;
- Use of selected cover materials; and
- Implementation of BMPs to minimize slope lengths, provide free drainage, and revegetate the post-mining surface.

In the geochemical data reported for the proposed waste rock facility (Schafer 2008b), arsenic levels are commonly elevated above the current Nevada drinking water standard (0.05 mg/L). Additionally, concentrations of several other water quality constituents were elevated above standards. It should be noted, however, that column tests provide an indication of interstitial water, and general fate and transport conclusions about water quality constituents would need to further account for hydrologic conditions at the facility.

The reclamation design for the proposed Clydesdale Waste Rock Facility consists of 12 inches of suitable topsoil material. In addition, a 6-foot-thick cover comprised of Carlin material or a combination of Carlin material and topsoil would be used as an evapotranspirative cover for waste rock with potentially acid generating properties. This cover technique has been successfully utilized on both the AA Leach Pad Facility and portions of the Bazza Waste Rock Facility and has demonstrated the ability to preclude or greatly reduce the infiltration of meteoric water into the underlying material. These covers have been investigated for their efficacy by both trenching and observation and through the use of instrumentation to measure the flux of meteoric water in the cover horizon. In addition, the moisture content of the proposed facility would generally be below field capacity, which is the point at which significant drainage would occur. Waters of the state would be protected by this approach. As a result, no substantial impacts to surface water quality are anticipated as a result of the materials that would be stored in the proposed Clydesdale Waste Rock Facility.

A similar approach to covering project components has already been employed at the mine by BGMI with considerable success. Reclamation at the existing AA Leach Pad utilized a cover with capillary barrier effects (CCBE), as well as a comprehensive drainage network on the surface to enhance surface water runoff and sediment control. Soon after the work was completed, an extremely intense storm event (1.6 inches of rainfall during a 20-minute period) occurred at the site on June 1, 2002. Damage on the reclaimed pad included rilling and gullying on the surface, and limited gullying within the drainage channels. BGMI also collected extensive hydrologic data, which indicated that the cover system maintained its overall integrity during the storm event. The results of the investigations indicate that there is a strong upward hydraulic gradient during non-precipitation periods due to evapotranspiration. In addition, there is no water seepage into the reclaimed pad, and no significant lateral flow was observed in the cover slopes. The observed draindown rates are steadily decreasing (i.e., without spikes), and closely follow the modeled rates (BGMI 2003).

Based on experience with this severe storm, BGMI revisited the design of surface drainage features at the AA Leach Pad and made repairs and upgrades. This experience is being carried on to the reclamation and closure design for other components, including the proposed components and the existing Bazza Waste Rock Facility (Schafer and Geosystems Analysis 2006). Surface drainage improvements include revised channel cross-sections, substantially thicker layers of constructed channel bed materials that promote armoring and limit scour, the placement of rock vortex weirs at selected locations, rigid boundary channel linings (e.g., articulated concrete blocks or oversized riprap) as needed, and constructed cascades of rock weirs and pools at selected locations (Schafer and Geosystems Analysis 2006).

Revegetation efforts on Carlin materials at the AA Leach Pad indicate that, although the growth of perennial cover may initially lag somewhat when compared to topsoil revegetation, the differences can be insignificant in as little as 2 years. In addition, the diversity and plant density of desirable woody species on Carlin materials are far superior to those on topsoiled areas. Active transpiration of deeper-rooted species continues well into the fall on the revegetated Carlin materials, as opposed to nearby native vegetation where plants become senescent in August.

Based on their experience, improved surface drainage practices, and successful cover results in the project area, BGMI would avoid or minimize long-term impacts to surface water resources from reclamation of the proposed components. Short-term impacts would be avoided by concurrent reclamation practices and storm water management.

The Goldstrike No. 3 Tailings Facility would be a lined and monitored facility operated and reclaimed in compliance with NDEP regulations. As described in Chapter 2.0, a network of gravel and perforated pipe underdrains would convey drainage from springs or seeps within the Brush Creek basin. In lieu of the gravel and perforated high-density pipe, fabric wrapped polyethylene wick drains may be used. Tailings delivered to this facility is planned to be a thickened product, which will result in a smaller water pool than conventional sub-aerial tailing facilities. Tailings will be deposited so that the beach angle falls away from the embankment. Any supernatant solution or storm water accumulation will be accumulated on the eastern side of the facility away from the dam embankment. The facility would have an over drain system located in the area of the supernatant pond to minimize any hydraulic head on the lining system. Solution from this system would be routed to the process circuit for reuse. Since the tailings delivered to this facility is to be thickened, the amount of water reporting to this system will be lower than that of a conventional facility. The facility will be designed to retain the Probable Maximum Flood (PMF) during operation.

Surface water run-on would be routed away from the facility by the existing Brush Creek Diversion, which is designed to safely accommodate the 100-year/24-hour runoff event (see discussion under the No Action Alternative). During operation of the Goldstrike No. 3 Tailings Facility, samples will be taken of the resident tailings and a characterization study will be performed (NAC 445A.431). Reclamation of the Goldstrike No. 3 Tailings Facility would entail contouring (through tailings deposition) to prevent pooling of meteoric water, placement of a soil cover, revegetation, and construction of a spillway. The spillway would be designed to safely pass the PMF and lesser runoff events. Drainage would be to the Rodeo Creek Diversion. Further details about the operation, reclamation, and closure of this facility are presented in Chapter 2.0.

The proposed features and practices used to manage this facility during operational and post-mining phases would avoid or minimize potential impacts to surface water resources. Further details about reclamation practices are presented in Chapter 2.0 and in the Reclamation Plan that accompanies the POO Amendment. The permanent closure procedures (including monitoring) for the proposed tailings facility would be defined and implemented according to NDEP regulations (NAC 445A.446-447) and the Final Permanent Closure Plan developed at that time. Inspections, and corrective actions if necessary, would be conducted during the reclamation and closure monitoring period. If over the long term, a stable and free-draining configuration at the tailings facility were compromised in some way, any discharges would collect in the Betze Pit.

3.4.2.3 Bazza Waste Rock Facility Alternative

Considerations for surface water resources under this alternative would consist of the same primary issues discussed for the No Action Alternative. Potential effects on surface flows, water quality, and flooding and sedimentation, as discussed for the No Action Alternative and the Proposed Action, would generally apply to this alternative as well. However, the potential impacts from the Clydesdale Waste Rock Facility and its associated haul roads (as discussed for the Proposed Action) would not apply to the Bazza Waste Rock Facility Alternative. Under this alternative, the stream stability and water quality impacts that may occur in Bell Creek and Rodeo Creek from the Proposed Action would be avoided.

Enlarging the Bazza Waste Rock Facility would consist of increasing its height while adhering to slope stability requirements. Due to the operating schedule and related nature of materials, lower quality growth media would be used on at least part of the facility, and reclamation would be delayed for a number of years. Depending on the design and construction of this alternative, steeper slopes may result when reclamation takes place. Potential impacts on surface water would differ somewhat from those of the No Action Alternative due to these factors.

Reclamation would be delayed for 7 years under this alternative. Since the SWPPP would be implemented for this alternative as well as the other alternatives, surface water impacts due to reclamation scheduling would be minimized.

Steeper slopes, if they occur, would accelerate runoff and erosion from the facility. This could degrade water quality in nearby surface drainages. If steeper slopes were near the top of the facility (i.e., restricted to the lifts raised by additional waste rock disposal), the potential for off-site water quality impacts would be less. Downslope benches, drains, and catchments would somewhat control the offsite movement of runoff and sediment. Control practices, including BMPs and structures to manage runoff and sediment, would need to be more substantial during and after operations in order to minimize potential impacts and comply with reclamation permit requirements.

Successful stabilization of the Bazza Waste Rock Facility would be more difficult to achieve under this alternative. The use of less suitable growth media would make revegetation success more difficult and time-consuming. When combined with the potential for steeper or longer slopes, the likelihood of long-term erosion and sedimentation impacts on surface water quality would be somewhat more than that of the No Action Alternative. BGMI would be bonded under regulatory requirements for reclamation. Given the state and federal requirements for successful reclamation and stabilization, and BGMI's extensive reclamation experience at the site, these impacts are not likely to occur. However, the impacts would be more difficult, expensive, and time-consuming to avoid.

3.4.3 Cumulative Impacts

The CESA for surface water resources is shown in **Figure 3.3-1**. The past and present actions and RFFAs in this area are identified in Section 3.1.

3.4.3.1 No Action Alternative

Cumulative impacts to surface water resources would result from other mining projects and watershed uses within the CESA. These impacts are within the area that was disclosed and mitigated in the 2000 and 2003 Betze SEIS (BLM 2000a, 2003a) as shown in **Figure 3.3-48** and described in Section 3.3.3.1.

In addition to mining activities, other watershed factors may create cumulative impacts to surface waters and related resources. Floods and wildfires are known to have occurred in the CESA, particularly during recent years in the Willow Creek, Maggie Creek, and Susie Creek watersheds (AATA 2006; BLM 2007b). In general, runoff, erosion, and sedimentation are substantially increased over the short term when wildfires occur. Flooding usually occurs as a result of burned watershed conditions until ground cover and soil conditions recover. The combination of these factors often leads to unstable stream channels and banks. In turn, adverse impacts on stream morphology, aquatic habitats, and water quality are likely until more resilient watershed conditions are restored.

Other surface water quality impairments already exist within the CESA or may be generated by watershed conditions in the future. Currently Maggie Creek is listed as impaired for total phosphorus and pH, and Simon Creek is impaired for TDS (NDEP 2005b). In addition, mercury accumulations have been reported in fish and surface water in six waterbodies in northern Nevada (NDOW 2005; NDEP 2007b,c). Fish sampling has shown that Comins Lake (White Pine County), Wildhorse Reservoir (Elko County), Chimney Reservoir (Humboldt County), Lahontan Reservoir (Churchill County), Rye Patch Reservoir (Pershing County), and Little Washoe Lake (Washoe County) each had multiple fish species with average wet weight methylmercury levels of 1.0 ppm or more. Fish consumption health advisories have been issued by the State of Nevada for each of these waterbodies, of which six are outside the CESA.

Mercury naturally occurs in geologic formations in northern Nevada, where it is often found as mercuric sulfide. The largest source of atmospheric mercury from Nevada industries is caused by processing gold through precious metals mining and processing operations (NDEP 2007b). However, the largest overall contributions

to atmospheric mercury in Nevada come from global sources outside the region. Mercury also is carried in smokestack emissions from coal-fired power plants, and the State of Nevada recently added a program to control mercury emissions from such sources, including gold mining operations. Continued mining and processing of precious metals in northern Nevada (along with other local and global sources) will continue to contribute to mercury concentrations in regional surface waters, possibly including those within the CESA. Section 3.11, Air Quality, provides a detailed discussion on mercury.

Cumulative impacts to water quality within the CESA also result from agricultural uses. Irrigation diversions and returns increase total dissolved solids concentrations and water temperatures, as well as introducing fertilizer, herbicide and pesticide constituents. Livestock grazing along stream corridors and at springs can reduce bank stability through trampling, and increase erosion, sedimentation, and fecal coliform concentrations. Water quantity is affected by consumptive uses through crop transpiration.

Other non-mining activities in the CESA include transportation and recreational uses of watersheds. These uses add to surface disturbance, particularly through unpaved roads and thoroughfares, which in turn provides sources of erosion and sedimentation. Suspended sediment increases turbidity, generally increases water temperature, and frequently increases biological oxygen demand. In combination, these factors create cumulative impacts to surface water quality and quantity.

3.4.3.2 Proposed Action

Cumulative impacts to surface water resources from the Proposed Action would be similar in nature, duration, and extent to those described for the No Action Alternative and in previous NEPA documentation (BLM 2000a,b, 2003a). The major proposed components, notably the Clydesdale Waste Rock Facility and Goldstrike No. 3 Tailings Facility, would occupy a minimal portion of the Boulder Creek watershed. Approximately 7,882 acres are currently authorized for disturbance under the No Action Alternative. The additional 1,180 acres that would be disturbed under the Proposed Action would bring the total project disturbance to approximately 9,062 acres, or about 2.6 percent of the Boulder Flat Hydrographic Basin (348,160 acres). This would be a minimal incremental increase in disturbance within the basin (less than 0.4 percent).

With respect to surface water quantity and quality, the proposed expansion would still be located above the valley fill sediments where most surface flows are lost to seepage and then to evapotranspiration or groundwater recharge. The additional disturbance would not change these conditions within the CESA. Water quality within the project area would be controlled by BGMI through the storm water control program, an agency-approved reclamation program, and ultimately the state closure program. All of these are conducted by BGMI during operations, or are under long-term bond. Little or no off-site water quality impacts are anticipated beyond those already described in previous NEPA documents (BLM 2000a, 2003a). With respect to potential cumulative impacts to surface water, there would be minimal difference between the Proposed Action and the No Action Alternative.

3.4.3.3 Bazza Waste Rock Alternative

Cumulative impacts to surface water resources from the Bazza Waste Rock Alternative would be similar in nature, duration, and extent to those described for the No Action Alternative and in previous NEPA (BLM 2000a, 2003a). The additional 608 acres that would be disturbed under the Bazza Waste Rock Alternative would bring the total project disturbance to approximately 8,490 acres, or about 2.4 percent of the Boulder Flat Hydrographic Basin (348,160 acres). This would be a minimal incremental increase in disturbance within the basin (less than 0.2 percent). With respect to potential cumulative impacts to surface water, there would be minimal difference between the Bazza Waste Rock Alternative and the No Action Alternative.

3.4.4 Mitigation Measures and Monitoring

No monitoring or mitigation is recommended for surface water resources. Existing monitoring and mitigation programs are sufficient for surface water resources.

3.4.5 Residual Impacts

Under the No Action Alternative, residual impacts to surface water resources would include the long-term impacts to flow magnitudes and durations in some perennial streams and springs from groundwater drawdown, and long-term modifications to the Rodeo Creek and Brush Creek stream channels. This impact has been discussed at length in earlier NEPA documents for the project (BLM 2000a, 2003a).

3.5 Soils and Reclamation

The study area for direct and indirect impacts for soils encompasses the undisturbed areas within the project boundary. The CESA encompasses the project boundary and includes surface disturbance associated with past and present actions and RFFAs within the Boulder Flat, Rock Creek Valley, Maggie Creek, and Marys Creek watersheds (**Figure 3.5-1**). The rationale for the selected CESA boundary is that this area contains the core Carlin Trend Mines that affect soil resources within watersheds that drain south to the Humboldt River. Soils within the currently permitted operations were described in the Betze Project EIS (BLM 1991a,b).

3.5.1 Affected Environment

The proposed project boundary lies within the Great Basin Section of the Basin and Range Province of the Intermountain Plateaus (USDA-NRCS 2006). Soils within the study area have developed on lower mountain slopes and hills including alluvial fans, pediments, and terraces. The dominant soil orders in this area are Aridisols and Mollisols.

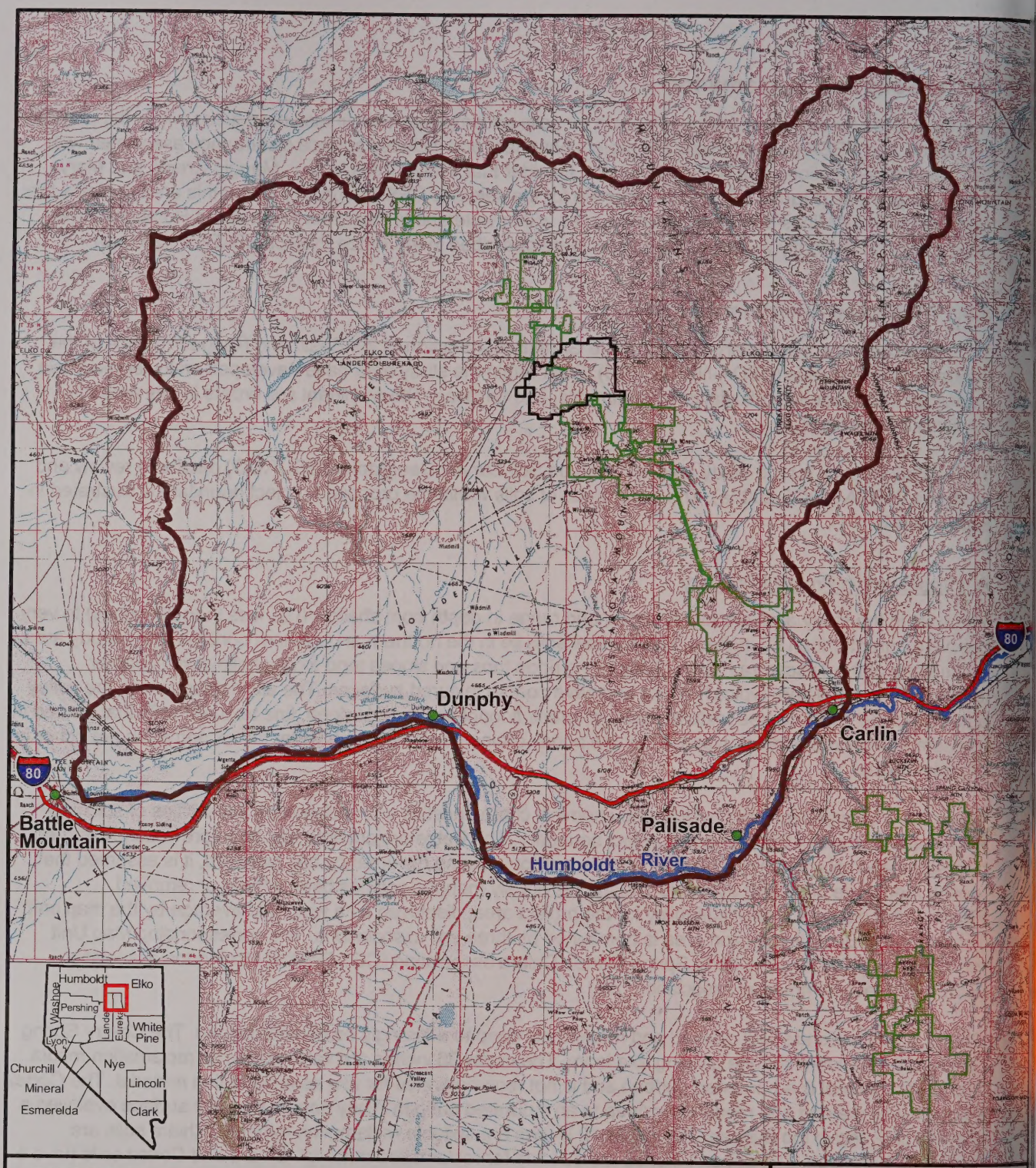
The soil information for the study area is based on Soil Survey Geographic (SSURGO) database review and analyses (USDA-NRCS 2007a). The occurrence of soils within the proposed project boundary is illustrated in **Figure 3.5-2**.

Soil Types within Project Boundary

The soils in the study area are highly varied and range in depth from shallow (i.e., less than 20 inches) to very deep (i.e., greater than 60 inches). The shallow soils lie in the northern and eastern portions of the study area at the base of the Tuscarora Range. Soils along ridge tops and slopes tend to be shallow with coarser textures. These soils are typically rocky and have coarse textured surfaces. The alluvial fans along the valley bottom include deep, coarse textured soils, whereas floodplains include deep, fine textured soils that formed in alluvium from mixed bedrock types. They are poorly drained soils with high water tables and often are richer in organic matter.

Table 3.5-1 summarizes the physical and chemical characteristics and reclamation suitabilities of soil map units that occur within the proposed project boundary. The Betze project area has been previously disturbed by historic and recent mining activities. Where previous mining disturbance has occurred, it is assumed that growth media are no longer available and the previously mapped soil has been altered or removed. **Figure 3.5-3** displays topsoil suitability for the project area, displayed as a weighted average by the map unit. The proposed Betze expansion area is dominated by three soil associations. The corresponding Map Unit Identification (MUIDs) are Cherry Spring-Cortez-Chiara association (CG), Boulflat-Havingdon association (BM), and Slaven-Primeaux association (SE).

Cherry Spring soils are well drained and moderately deep to a strongly cemented duripan. The Cherry Spring series has a silt loam surface grading to a loam. The upper 36 inches are salvageable as reclamation media. The lower material is a hardened duripan and is not recommended for use as reclamation material. The Cortez soils are well drained and moderately deep to an indurated duripan. They have a silt loam surface overlying a gravelly clay above the duripan. The upper 10 inches are suitable reclamation material. Chiara soils are shallow to a duripan. The upper 4 inches are suitable for reclamation material. Chiara and Cortez soils have a saline-sodic subsoil beneath the duripan and should not be salvaged as reclamation material; these soils occur on fan piedmont remnants in the northern and western portions of the study area. Boulflat soils are moderately deep and well drained. These soils have a gravelly loam surface grading to a gravelly clay loam. The upper 13 inches can be salvaged as growth media; a duripan occurs at 23 inches. The Havingdon series consist of moderately deep, well drained soils. The Havingdon soils have a gravelly surface and a very gravelly subsoil overlying lithic bedrock. The upper 6 inches is suitable growth media. The Boulflat-Havingdon association occurs on mountain and foothill crests, side slopes, and shoulders. They occur in the northern portion of the study area. The Slaven soils are moderately deep, well drained soils that occur on hills and mountain side



LEGEND

- Soil Cumulative Effects Study Area
- Goldstrike Mine Operations Boundary
- Mine Plan Boundaries
- Towns

N

0 2.5 5 10 Miles

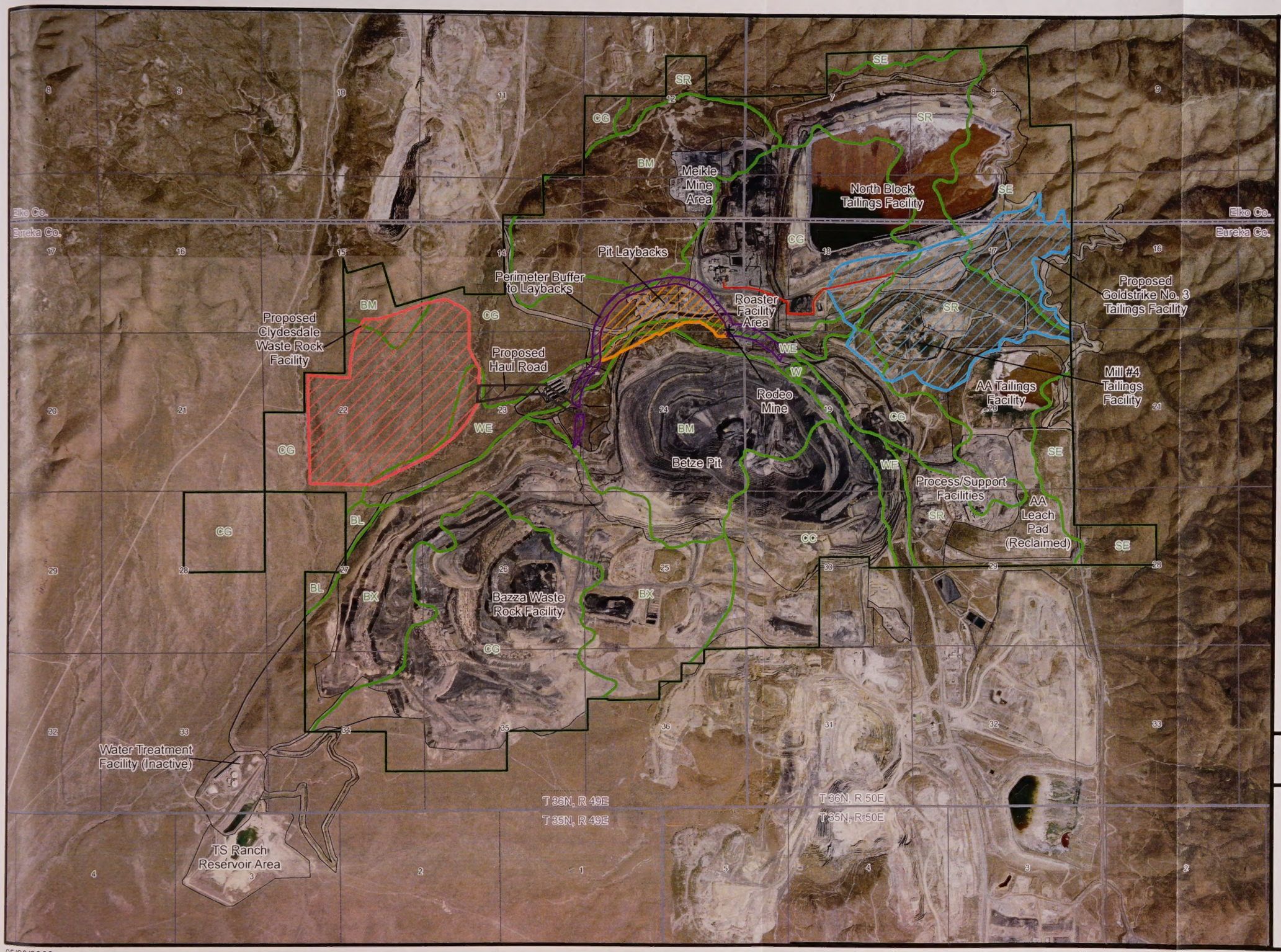
Source: BLM 2007b,c.

Betze Pit Expansion Project

Figure 3.5-1

Soil Resources Cumulative Effects Study Area

06/5/2008



LEGEND

- Goldstrike Mine Operations Boundary
- Rodeo Backfill Shaft
- Tailings
- Pit Expansion
- Perimeter Buffer to Laybacks
- Waste Rock Facility
- Clydesdale Haul Road
- Tailings Pipeline

SSURGO Soils

BL = Bosco-Welch association

BM = Boulflat-Havingdon association

BX = Bucan-Humdun association

CC = Chen-Pie Creek-Ramires association

CG = Cherry Spring-Cortez-Chiara association

SE = Slaven-Primeaux association

SR = Stampede-Donna association

W = Water

WE = Welch-Bosco association

Source: USDA-NRCS 2007a.

N W E S

0 0.5 1 Miles

Betze Pit Expansion Project

Figure 3.5-2

Soil Types within the Proposed Project Boundary

Table 3.5-1 Physical and Chemical Characteristics and Reclamation Suitabilities of Soil Map Units Occurring within the Proposed Project Boundary

MUID[1]	Map Unit Name	Horizon	Acres	Depth (inches)		Geomorphic Description	Erosion Hazard of Bare Surface		Hydric Rating	Topsoil Suitability	Limiting Factors[4]	RSD[5] (inches)
				Top	Bottom		Water[2]	Wind[3]				
SE	Slaven-Primeaux association (Slaven)	H1	836	0	5	mountain	moderate	slight	No	Poor	D, OM, BR, T, R, slope	0
		H2		5	22		slight		No			
		H3		22	26				No			
	Slaven-Primeaux association (Primeaux)	H1		0	11	mountain	severe	slight	No	poor	OM, BR, D, slope, R	20
		H2		11	20		severe		No			
		H3		20	35		moderate		No			
		H4		35	39				No			
	Slaven-Primeaux association (Cumulic Haplaquolls)	H1		0	5	flood plain	severe	moderate	Yes	fair	D, W	5
SR	Stampede-Donna association (Donna)	H1	1,6123	0	8	fan remnant	moderate	slight	No	poor	T, D, E, R	22
		H2		8	22		moderate		No			
		H3		22	38				No			
		H4		38	68		slight		No			
	Stampede-Donna association (Stampede)	H1		0	12	fan remnant	severe	slight	No	poor	T, D, E, OM, slope	28
		H2		12	28		moderate		No			

Table 3.5-1 Physical and Chemical Characteristics and Reclamation Suitabilities of Soil Map Units Occurring within the Proposed Project Boundary

MUID[1]	Map Unit Name	Horizon	Acres	Depth (inches)		Geomorphic Description	Erosion Hazard of Bare Surface		Hydric Rating	Topsoil Suitability	Limiting Factors[4]	RSD[5] (inches)
				Top	Bottom		Water[2]	Wind[3]				
		H3		28	33				No			
		H4		33	60		slight		No			
CG	Cherry Spring-Cortez-Chiara association (Cherry Spring)	H1	3555	0	15	fan remnant	severe	moderate	No	fair	Na, R, A, E, OM	36
		H2		15	36		severe		No			
		H3		36	54				No			
		H4		54	60		slight		No			
	Cherry Spring-Cortez-Chiara association (Chiara)	H1		0	4	fan remnant	severe	moderate	No	poor	NA, D, Na, E, OM	4
		H2		4	13		severe		No			
		H3		13	17				No			
	Cherry Spring-Cortez-Chiara association (Cortez)	H1		0	10	fan remnant	severe	moderate	No	poor	T, Na, R, A, S, OM	10
		H2		10	22		slight		No			
		H3		22	48				No			
		H4		48	60		slight		No			
BM	Boulflat-Havingdon association (Boulflat)	H1	1,740	0	4	hill	moderate	slight	No	poor	slope, R, BR, D, OM	13

Table 3.5-1 Physical and Chemical Characteristics and Reclamation Suitabilities of Soil Map Units Occurring within the Proposed Project Boundary

MUID[1]	Map Unit Name	Horizon	Acres	Depth (inches)		Geomorphic Description	Erosion Hazard of Bare Surface		Hydric Rating	Topsoil Suitability	Limiting Factors[4]	RSD[5] (inches)
				Top	Bottom		Water[2]	Wind[3]				
		H2		4	13		slight		No			
		H3		13	23		slight		No			
		H4		23	34				No			
		H5		34	38				No			
	Boulflat-Havingdon association (Havingdon)	H1		0	6	hill	severe	slight	No	poor	slope, R, T, BR, OM	6
		H2		6	21		slight		No			
		H3		21	25				No			
	Boulflat-Havingdon association (Brock)	H1		0	5	fan remnant	severe	slight	No	poor	slope, R, D, OM	0
		H2		5	14		slight		No			
		H3		14	18				No			
WE	Welch-Bosco association (Welch)	H1	482	0	7	flood plain	moderate	moderate	No	fair	R, T	60 +
		H2		7	60		slight		No			
	Welch-Bosco association (Bosco)	H1		0	15	flood plain	slight	slight	No	poor	R, D, OM	15
		H2		15	46		slight		No			

Table 3.5-1 Physical and Chemical Characteristics and Reclamation Suitabilities of Soil Map Units Occurring within the Proposed Project Boundary

MUID[1]	Map Unit Name	Horizon	Acres	Depth (inches)		Geomorphic Description	Erosion Hazard of Bare Surface		Hydric Rating	Topsoil Suitability	Limiting Factors[4]	RSD[5] (inches)
				Top	Bottom		Water[2]	Wind[3]				
		H3		46	70		slight		No			
	Welch-Bosco association (Welch)	H1		0	5	flood plain	moderate	moderate	Yes	fair	W, T, R	60 +
		H2		5	60		slight		Yes			
BX	Bucan-Humdun association (Bucan)	H1	1,293	0	7	hill	severe	slight	No	poor	slope, T, R, OM	7
		H2		7	25		severe		No			
		H3		25	50		slight		No			
		H4		50	54				No			
	Bucan-Humdun association (Bucan)	H1		0	7	hill	moderate	slight	No	poor	slope, T, R, OM	7
		H2		7	25		severe		No			
		H3		25	50		slight		No			
		H4		50	54				No			
	Bucan-Humdun association (Humdun)	H1		0	8	mountain	severe	moderate	No	poor	slope, OM, E	30
		H2		8	30		severe		No			
		H3		30	60		severe		No			

Table 3.5-1 Physical and Chemical Characteristics and Reclamation Suitabilities of Soil Map Units Occurring within the Proposed Project Boundary

MUID[1]	Map Unit Name	Horizon	Acres	Depth (inches)		Geomorphic Description	Erosion Hazard of Bare Surface		Hydric Rating	Topsoil Suitability	Limiting Factors[4]	RSD[5] (inches)
				Top	Bottom		Water[2]	Wind[3]				
CC	Chen-Pie Creek-Ramires association (Chen)	H1	645	0	8	mountain	slight	slight	No	poor	slope, T, R, BR, OM, D	0
		H2		8	17		slight		No			
		H3		17	21				No			
	Chen-Pie Creek-Ramires association (Pie Creek)	H1		0	5	hill	slight	slight	No	poor	slope, T, BR, D	21-30
		H2		5	21		moderate		No			
		H3		21	30		moderate		No			
		H4		30	34				No			
	Chen-Pie Creek-Ramires association (Ramires)	H1		0	9	mountain	slight	slight	No	poor	slope, T, R, BR, OM, D	26-34
		H2		9	26		moderate		No			
		H3		26	34		slight		No			
		H4		34	38				No			
	Chen-Pie Creek-Ramires association (Cumulic Haplaquolls)	H1		0	5	flood plain	severe	moderate	Yes	fair	W, D	5
BL	Bosco-Welch association (Bosco)	H1	47	0	15	flood plain	moderate	slight	No	poor	R, D, OM	15

Table 3.5-1 Physical and Chemical Characteristics and Reclamation Suitabilities of Soil Map Units Occurring within the Proposed Project Boundary

MUID[1]	Map Unit Name	Horizon	Acres	Depth (inches)		Geomorphic Description	Erosion Hazard of Bare Surface		Hydric Rating	Topsoil Suitability	Limiting Factors[4]	RSD[5] (inches)
				Top	Bottom		Water[2]	Wind[3]				
		H2		15	46		slight		No			
		H3		46	70		slight		No			
	Bosco-Welch association (Welch)	H1		0	7	flood plain	severe	moderate	No	fair	R, T	60
		H2		7	60		moderate		No			
	Bosco-Welch association (Welch)	H1		0	5	flood plain	severe	moderate	Yes	fair	W, T, R	60
		H2		5	60		moderate		Yes			

[1]Map Unit Identification.

[2]Water erosion hazard class determined from Soil Erodibility Factor (Kw) and slope.

[3]Wind erosion hazard class based on Wind Erodibility Group Rating.

[4]Limiting Factors:

A = High Alkalinity
BR = Depth to Bedrock
C = High Carbonates
D = Droughty
E = Erosion
Na = Sodium Content
OM = Low Organic Matter
R = Rock Fragments
S = Salinity
Slope = Slope
SD = Too Sandy
T = Too Clayey
W = Depth to Watertable

[5]Recommended Soil Salvage Depth.

Source: USDA-NRCS 2007a.

Betze Pit Expansion Project

Figure 3.5-3

Topsoil Storage Suitability within the Project Boundary

slopes. The entire soil profile is very to extremely gravelly to lithic bedrock and is not recommended for growth media. The Primeaux series consist of moderately deep well drained soils that occur on uplands. The upper 20 inches is suitable for growth media. The SE association is found in the northern and eastern portions of the study area.

The Welch-Bosco and Bosco-Welch associations occur to a smaller extent in the mid-western portion of the study area on flood plains, stream terraces, and inset fans. The Welch series are very deep, poorly drained and very poorly drained soils. These soils are very fertile and have a clay loam surface and subsoil. The entire profile (60+ inches) is suitable for growth media. The Bosco series are very deep and are somewhat excessively drained. They occur on nearly level, recent stream terraces and deltaic fans at the mouth of streams. The soil is very gravelly throughout the profile.

In summary, most of the undisturbed soils found within the Betze expansion area have suitable growth media characteristics in the upper portions of the soil profiles. The underlying substratum is not recommended for salvage as growth media in all but floodplain soils due to rock fragments and/or undesirable physical and chemical properties. Where an indurated duripan is encountered, soil salvage activities should be halted.

Since BGMI began operating the Goldstrike Mine in 1987, topsoil has been stripped from all disturbed areas and stockpiled. Prior to 1987, a comprehensive topsoil removal program had not been initiated, so not all of the available topsoil was recovered for reclamation. However, growth media shortages are not anticipated because, in addition to topsoil, pit alluvium from the Carlin Formation would be used for reclamation. Carlin material was utilized as growth media on selected areas for reclamation of the AA Leach Pad. Over time the Carlin material had a higher cover of perennial grasses and shrubs (**Figure 3.5-4**) than the topsoiled areas and fewer annual exotic species (Zhan et al. 2006). The Carlin material used for reclamation of the Bazza Waste Rock Facility would likely have higher gravel and cobble contents and lower plant available water capacity. Textures range from silt loam to loamy sand. BGMI estimates that available topsoil stockpiles, in conjunction with the 49 million tons of mined Carlin material, would be sufficient for reclamation efforts outlined in the Reclamation Plan.

3.5.2 Environmental Consequences

Mining activities could impact the soil resource when soils are disturbed. Impacts also may occur post-mining when the final growth medium is redistributed during reclamation activities. Issues related to soils and reclamation during the proposed Betze Pit Expansion Project include the following:

- Potential erosion impacts;
- Availability of suitable soils and growth media for revegetation; and
- Potential for successfully reclaiming mine-related disturbance.

Erosion

Susceptibility to erosion is a function of characteristics such as soil texture and structure, topography, surface roughness, soil cover (made up of vegetation, duff/litter, rock, and woody debris), and climate. Erosion also may be influenced by the length of time the soils are bare and by disruption of drainage and erosion control structures. Erosion resulting from water occurs primarily on loose, non-cohesive soils on moderate to steep slopes, particularly during high intensity storm events. Soil erosion is typically accelerated on slopes with lower than average drainage density. Wind-induced erosion often occurs on dry, fine, sandy soils where vegetation cover is sparse and strong winds are prevalent.

Soils subject to water erosion include steeply sloping land with shallow soils. Erosion hazard of the native soils across the project area are shown in **Table 3.5-1**. Sandy and silty textured, sparsely vegetated



Figure 3.5-4 **Carlin Material Vegetative Cover on AA Pad in 2006 Leach Pad at Treatment Area H6 with 3:1 Slope and West Aspect (Cedar Creek Associates 2007a)**

soils are subject to wind erosion. Although accelerated erosion due to mining-related soil disturbance could occur at any stage of the project, the maximum potential for erosion within the study area would be expected while soils are loose, with no established cover. Erosion also will be of concern after reclamation work has occurred but before a vegetative cover has been reestablished. If the ground surface is left smooth and bare during this period, winds could dislodge soil particles and rainfall intercepting bare surfaces could result in increased erosion.

Soil Productivity

The mixing of soil horizons during excavation, piling, and reapplication for reclamation would lower soil productivity by diluting the physical, biological, and chemical properties of the topsoil with less productive subsoil. Segregation of topsoil helps to mitigate these effects. If topsoil is lost, mitigation can be difficult because it may take many years for a topsoil horizon to form naturally.

Physical and chemical properties such as high sodium content, high alkalinity, low organic matter, high salinity, rock fragments, high carbonates, and high sand or clay content have a negative effect on soil productivity and can alter revegetation potential and other reclamation work.

Soil Compaction and Rutting

Soil compaction occurs when soil particles are pressed together and the pore spaces between them are reduced while bulk density is increased. Moist fine textured soils are most susceptible to severe compaction. However, compaction also may occur on loamy to coarse textured soils and under drier conditions due to multiple passes by heavy mechanical equipment.

Soil that is excessively compacted is limited in its ability to function. Compaction damages soil structure and reduces pore space, which impedes the movement of air and water to plant roots and can result in lower growth rates and hinder revegetation. Compaction reduces infiltration and results in excessive surface runoff, erosion, nutrient loss, and potential water-quality problems. Detrimental soil compaction, when extreme and unmitigated, can result in an irretrievable reduction in soil productivity.

Rutting occurs when the soil strength is not sufficient to support the applied load from vehicle traffic. Rutting affects the surface hydrology of a site as well as the rooting environment. The process of rutting physically severs roots and reduces the aeration and infiltration of the soil, thereby degrading the rooting environment. Rutting also disrupts natural surface water hydrology by damming surface water flows, creating increased soil saturation upgradient from ruts, or by diverting and concentrating water flows creating accelerated erosion. Rutting is most likely to occur on moist or wet fine textured soils but also may occur on dry sandy soils due to their low soil strength.

Soil compaction and rutting could result from the movement of heavy mining vehicles. The degree of compaction would depend on the moisture content and texture of the soil at the time of impact. Compaction would be most severe where heavy equipment operates on moist to wet soils with high clay contents. Detrimental compaction also can occur on soils of various textures and moisture contents if multiple passes are made by high ground-weight equipment (i.e., rubber-tired heavy equipment).

Soil Contamination

Soil contamination could result from material spills during mining activities. If large spills occur, contamination could result in the removal and disposal of large amounts of soil. Saturated soils have the potential to diffuse contaminants.

Soil Crusts

Biological soil crusts are considered an important component in dry arid ecosystems. In dry arid environments biological soil crusts are essential for soil stability due to less vegetative growth and soil

cover. They provide soil stability, prevent erosion, fix nitrogen, increase infiltration rates, and may reduce noxious weed migration. No data exists on soil crust coverage of the study area, however, research shows that biological soil crusts do best where sedimentary parent materials are found (Belnap et al. 2003). Crusts are very sensitive to ground disturbances, but in moister sagebrush habitats, crusts should begin to recover within a couple decades and form reasonably well developed communities after a few more decades (Nevada Department of Conservation and Natural Resources 2002).

Reclamation

During development of mining projects in Nevada, suitable soil resources and/or growth media substitutions are salvaged as land disturbance proceeds. These materials typically are stockpiled and protected for later use in seedbed reconstruction during agency-approved reclamation programs.

State and federal regulatory programs that address project reclamation are administered by the NDEP and BLM. Within NDEP, the BMRR oversees reclamation planning and bonding for state and private lands as required under NAC Chapter 519A.010-519A.415. In addition, a Memorandum of Understanding (MOU) for Mining and Mineral Related Activities exists between NDEP, BLM, and the USFS to coordinate the state and federal reclamation programs. Entered into in July 2002, this agreement ensures that adequate reclamation planning and programs address affected lands within a study area.

Under the MOU and applicable regulations, mining companies must develop detailed reclamation plans and establish financial assurances for their successful implementation. Such plans address concurrent reclamation and stabilization practices that are implemented as a project proceeds, as well as post-mining practices that are implemented during the final stages of project completion. Concurrent reclamation typically consists of revegetation, erosion controls, and associated drainage practices that minimize the impacts of clearing and accelerated erosion during project activities. Final reclamation is conducted following completion of mining and processing activities.

Final reclamation programs are oriented to control accelerated erosion, sedimentation, and drainage, as well as protect public safety and restore approved productive land uses. Typically, to address this latter objective, productive vegetation communities must be successfully re-established as an outcome of recontouring, growth media reconstruction, and revegetation efforts.

As part of agency activities under the CWA, NDEP also administers the USEPA-approved state program to issue storm water permits. This program involves additional regulations for controlling accelerated erosion and sedimentation, storm water drainage and discharges, and associated water quality. Plans and activities implemented under this program also avoid or minimize potential impacts to soil resources, and promote overall site stabilization as a project proceeds. Water quality regulations and related guidance for mining projects are administered by NDEP under NAC Chapter 445A. These regulations also form part of the inter-agency MOU for Mining and Mineral Related Activities.

3.5.2.1 No Action Alternative

The proposed expansion of the Goldstrike Mine would not occur under the No Action Alternative, and associated impacts to soils from further mining or processing components would not occur. Under this alternative, the existing mine would continue to operate as currently authorized.

Rodeo Creek Diversion

Rodeo Creek would be diverted from its current alignment north of the Betze Pit and routed south of the pit (**Figure 2-4**). Where diverted, the hydric soils associated with the current Rodeo Creek alignment would be permanently altered. The soils currently associated with Rodeo Creek are the Welch-Bosco association. These soils formed from alluvial processes on floodplains and stream terraces. The soils that become associated with the diversion may take on hydric characteristics.

Soil Suitability and Reclamation Success

Reclamation procedures and schedules would continue unchanged. Growth media resources have been salvaged to the extent practical during current mining activities, and reclamation progress has been satisfactory under approved state and federal guidelines. Reclamation of the Bazza Waste Rock Facility would continue to proceed in stages and would not be completed until 2018. Less Carlin formation growth media would be available for use in reclamation of the Bazza Waste Rock Facility, potentially affecting reclamation success.

Water Management Activities

The groundwater drawdown effect associated with a continuation of dewatering activities through 2015 under the No Action Alternative may have drying effects on the hydric soils associated with wetlands, seeps, and springs within the predicted 10-foot drawdown contour (**Figure 3.3-26**). This would change the microbial and chemical characteristics of the soils and alter the vegetative community. The projected 10-foot drawdown contour for the No Action Alternative is similar to the 10-foot drawdown contour projected in the Betze Project SEIS (BLM 2000a, 2003a) (**Figure 3.3-26**). As a result, impacts to hydric soils are predicted to be similar to the impacts described in the Betze Project SEIS. These impacts to hydric soils are within the cumulative effects 10-foot drawdown area that was disclosed and mitigated for in the Betze SEIS (BLM 2000a, 2003a) as shown in **Figure 3.3-48**. Upland soils would not be affected by groundwater drawdown.

3.5.2.2 Proposed Action

Surface Disturbance

The proposed expansion of the Betze project area would result in approximately 1,180 acres of new disturbance to soils.

Soil Suitability and Reclamation Success

Soil mapping units that are located in proposed disturbance areas are shown in **Figure 3.5-2**. Replacement of vegetative growth media is proposed for major disturbances associated with the proposed project. Salvaged growth media would comprise both native soil materials and Carlin Formation pit alluvium. The Carlin Formation material is physically and chemically suitable for plant growth, and has successfully been used for revegetation efforts within the currently authorized project area. The recommended salvage depth for native soil material is identified in **Table 3.5-1**.

Much of the disturbance from the proposed expansion of the Betze Pit and Clydesdale Waste Rock Facility would occur where the Cherry Spring-Cortez-Chiara soils are mapped. These soils are shallow to moderately deep to a duripan and are gently sloping. The proposed Goldstrike No. 3 Tailings Facility would be constructed over the existing (inactive) Mill No. 4 Tailings Facility and would occur where the Stampede-Donna association is mapped. The Stampede series is moderately deep to a duripan. The upper 12 inches should be recovered for use as growth media. The clay subsoil from 12 to 28 inches may be recovered and stockpiled separately for use as an evapotranspiration cover for the reclamation of the Clydesdale Waste Rock Facility. The haul road from the Betze Pit to the Clydesdale Waste Rock Facility would cross the Welch-Bosco floodplain soils. The Welch series is poorly drained with a thick dark organic surface. Where disturbed, the entire soil profile can be salvaged for reclamation. However, these are sensitive and productive soils, so disturbance should be avoided where possible. The Bosco series is a gravelly loam throughout the profile and somewhat excessively drained. The upper 15 inches of the Bosco series may be salvaged. The high gravel content can be diluted through mixing or may be used as a mulch type of material to retain water. See **Table 3.5-1** for approximate recovery depths.

Overall site productivity is primarily a matter of revegetation success. Productivity varies with vegetation community, but more importantly, with land management objectives as they relate to the establishment of

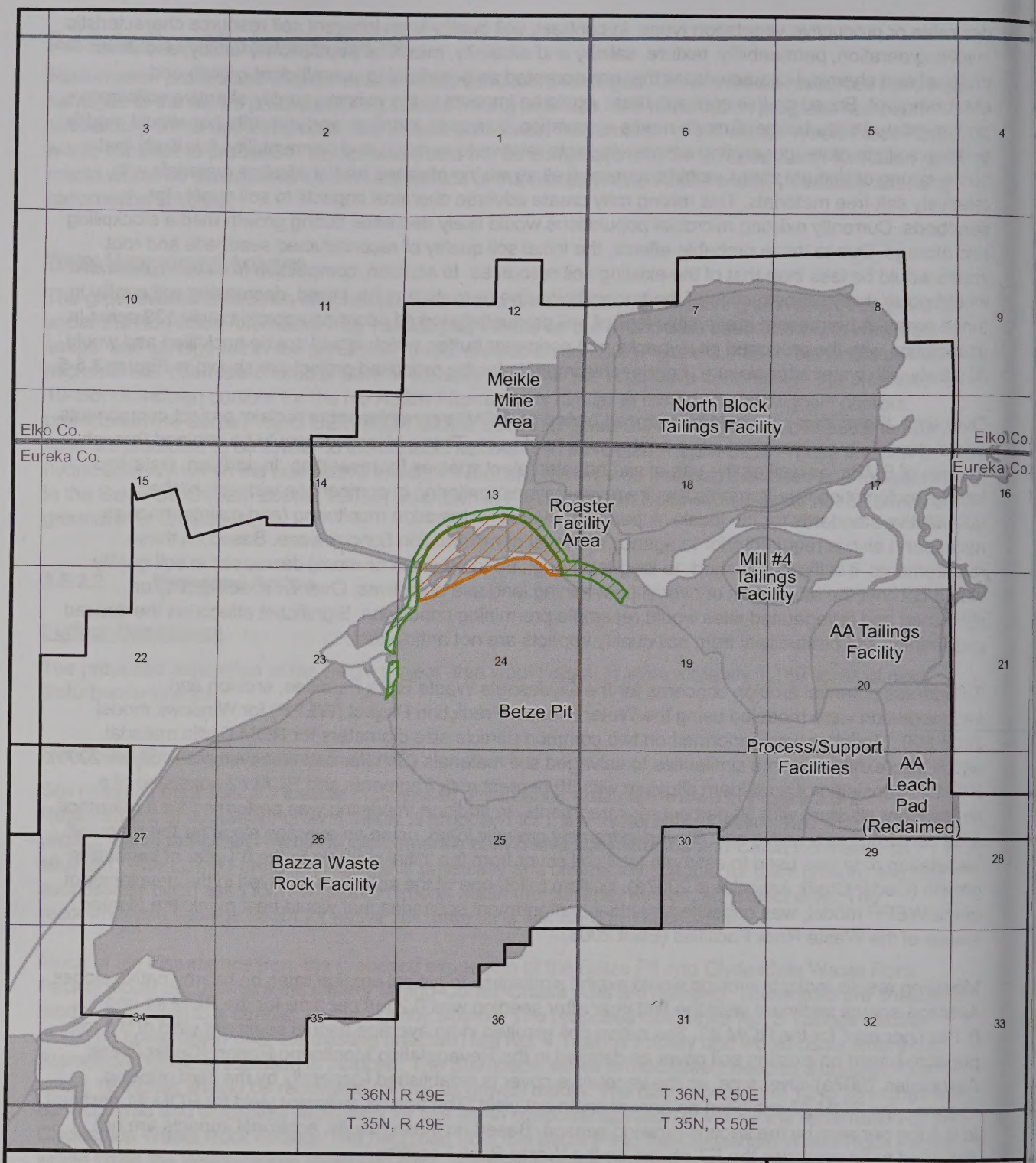
desirable or productive vegetation types. In contrast, soil quality is an inherent soil resource characteristic involving aeration, permeability, texture, salinity and alkalinity, microbial populations, fertility, and other physical and chemical characteristics that are accepted as beneficial to overall plant growth and establishment. Based on this concept, there would be impacts to the existing quality of native soils from project-related disturbance. Growth media excavation, transport, storage, and redistribution would modify existing soil structure, generating adverse impacts relative to aeration and permeability. It is likely that some mixing of textural zones would occur, as well as mixing of saline and/or alkaline materials with relatively salt-free materials. This mixing may create adverse chemical impacts to soil quality for seedbeds. Currently existing microbial populations would likely decrease during growth media stockpiling and storage. Due to these probable effects, the initial soil quality of reconstructed seedbeds and root zones would be less than that of the existing soil resources. In addition, compaction from vehicular traffic would occur during construction of the transmission line re-route and haul road, decreasing soil quality in those areas. A permanent irreversible loss of soil productivity would occur on approximately 129 acres in association with the proposed pit laybacks and perimeter buffer, which would not be backfilled and would fill slowly with water after closure. Irretrievable impacts for the proposed project are shown in **Figure 3.5-5**.

Over time, these impacts would be reduced based on BGMI's commitment to reclaim project components and successfully restore productive post-mining land uses. These objectives would be attained through the use of BMPs, as well as the use of site-adapted plant species for reseeding. In addition, state and federal reclamation requirements require revegetation monitoring in comparison with established quantitative standards for the locale. A period of overall reclamation monitoring (and maintenance as necessary) also is required prior to agency approval of reclamation bond release. Based on these requirements, it is likely that short- to long-term (e.g., up to 10 years or more) decreases in soil quality would not limit the attainment of overall post-mining land use objectives. Over time, soil quality on reclaimed and revegetated sites would resemble pre-mining conditions. Significant effects on the desired post-mining site productivity from soil quality impacts are not anticipated.

To address potential erosion concerns for the Clydesdale Waste Rock Facilities, erosion and sedimentation were modeled using the Water Erosion Prediction Project (WEPP) for Windows model 2006.500. Modeling was performed on two common particle size diameters for ROM Carlin material, which also exhibited some similarities to salvaged soil materials (Schafer and Geosystems Analysis 2006). ROM #1 consisted of a silt loam alluvium with 50 percent rock fragments and ROM #3 consisted of a sandy loam alluvium with 50 percent rock fragments. In addition, modeling was performed for a reference area consisting of a native soil, Slaven extremely gravelly loam, using an average slope for the map unit. Vegetation data was used to estimate total soil cover from the initial planting to the 6th year of vegetative growth (Cedar Creek Associates 2007a). William Elliot, one of the scientists involved in the development of the WEPP model, was consulted for ideal management scenarios that would best mimic the planted slopes of the Waste Rock Facilities (Elliot 2008).

Modeling results indicate erosion would exhibit similarities to typical erosion rates on nearby native slopes. Average annual sediment yield the first year after seeding was 0.2 ton per acre for the ROM #1 and 0.1 ton per acre for the ROM #3. The native soil resulted in an average annual sediment yield of 0.1 ton per acre based on existing soil cover as detailed in the Revegetation Monitoring Report (Cedar Creek Associates 2007a). Over time, as the vegetative cover is established (generally by the third growing season), the ROM #3 exhibited no annual sediment yield. The annual sediment yield for ROM #1 declined to 0.1 ton per acre by the second growing season. Based on these results, erosional impacts are not expected to compromise the ET covers on the Waste Rock Facilities.

An additional issue for the Proposed Action concerns the final reclamation configuration of the Clydesdale Waste Rock Facility. Hillslope and drainage characteristics of the proposed component are of concern, given recent storm and drainage impacts on mining components in the region. As indicated in the Surface Water discussion (Section 3.4), a substantial storm event occurred in the BGMI project area shortly after reclamation activities had been completed at the AA Leach Pad. Although overall cover integrity was successfully maintained, the surface drainage system required re-design and repair. As a result, these



LEGEND

- Goldstrike Mine Operations Boundary
- Pit Expansion; Irretrievable Impact
- Perimeter Buffer to Laybacks; Irretrievable Impact

N

0 0.25 0.5 1 Miles

Source: BGMI and SRK 2007; BGMI 2007a.

Betze Pit Expansion Project

Figure 3.5-5

Irretrievable Impacts to Soil Resources

06/25/2008

revised design concepts have been carried forward in current site activities, as well as in the existing Final Permanent Closure Plan for the Bazza Waste Rock Facility (Schafer and Geosystems Analysis 2006).

Due to a number of resource considerations and potential impacts, the reclaimed Clydesdale Waste Rock Facility should have similar soil and drainage characteristics, vegetation, and habitat when compared to natural hillslopes in the vicinity of the project. For this to be possible, slope stability and soil erosion rates need to approximate those that exist nearby. To accomplish this, it is recommended that constructed drainage basins should have drainage areas, basin relief ratios, valley gradients, and drainage densities that are similar to those found in undisturbed areas nearby. In addition, channels should have geomorphic characteristics that are comparable to those found on undisturbed hillslopes nearby. In order to achieve these goals and mitigate potential adverse impacts related to site stability, surface drainage, wildlife habitat, and visual resources, additional mitigation is recommended (SOILS-1).

Although preliminary component designs for the Proposed Action are sufficient to proceed with NEPA assessments, additional design work remains to be completed if the Proposed Action were to actually be undertaken. As a result, BLM-approved design criteria such as drainage density, basin relief ratios, achievable average hillslopes, and other geomorphic and drainage characteristics have not yet been determined for the Clydesdale Waste Rock Facility.

3.5.2.3 Bazza Waste Rock Facility Alternative

The impacts associated with this alternative would be similar to the Proposed Action except soil disturbance would be approximately 572 acres less because the Clydesdale Waste Rock Facility and the haul road associated with the facility would not be constructed. Impacts associated with construction, operation, and reclamation of the Clydesdale Waste Rock Facility would not occur.

The distance traveled between the pit and the Bazza Waste Rock Facility would be increased. With increased distance traveled, there is an increased risk of displacement and rutting when the road is wet. Traffic induced dust emissions and related wind erosion could increase. There could be additional impacts associated with increased road maintenance on the existing haul road to the Bazza facility. Typically, immediately after a native surface or graveled road is maintained erosion increases. Surface erosion is dependent on soil type, road surfacing, road grade, age of the road, traffic volumes, maintenance practices, and the effectiveness and spacing of drainage features. Very fine soils are easily displaced and rutted when wet. Coarse soils with few fines have little cohesiveness and can be easily eroded. Typically, native surface roads experience greater erosion of the road surface than do graveled roads. BMPs would be implemented to reduce these impacts, including storm water and dust controls.

Under the Bazza Waste Rocky Facility Alternative, reclamation on the Bazza Waste Rock Facility would occur approximately 7 years later than with the Proposed Action. This would result in extended storage of the reclamation material such as Carlin material and soil growth media. Long-term and increased storage of Carlin material has proven difficult due to slope stability issues, safety, and low soil strength when wet (see Section 2.4, Bazza Waste Rock Facility Alternative). Much of the Carlin Material from the pit alluvium would be disposed of in the Bazza facility due to poor storage ability and would be unavailable for reclamation use. Under this alternative, the height of the Bazza Waste Rock Facility would increase by approximately 100 feet over the maximum height of the facility under the Proposed Action. Waste rock would be handled according to the Bazza Waste Rock Management Plan (Schafer and Geosystems 2004) and the facility reclaimed according to the reclamation plan.

It is assumed for this alternative that reclamation of higher elevation lifts on the Bazza Waste Rock Facility would follow the approach set forth in the Final Permanent Closure Plan for the Bazza Waste Rock Facility (Schafer and Geosystems Analysis 2006). A geomorphic approach to reclamation was analyzed in that document, and surface drainage configurations and stability were considered in detail. As described for the proposed Clydesdale Waste Rock Facility under the Proposed Action assessment, the erosion rates of Carlin materials were modeled using the WEPP for Windows 2006.500. Very low erosion rates were predicted from average slopes. Even if topsoil or other growth media were used, erosion from reclaimed

Bazza waste rock slopes would likely be within soil loss tolerances. Surface erosion is not expected to compromise the ET cover or revegetation success for the Bazza Waste Rock Facility alternative.

3.5.3 Cumulative Impacts

The CESA (**Figure 3.5-1**) encompasses the project boundary and includes surface disturbance associated with past and present actions and RFFAs within the Carlin Trend and the soils that drain the Carlin Trend to the confluence with the Humboldt River (Section 3.1).

Information on soil resource disturbances in the CESA was developed from aerial photo interpretation, soil survey information, and previous EISs.

3.5.3.1 No Action Alternative

Dewatering impacts associated with nearby mining activities, including the Goldstrike Mine, will continue to contribute to cumulative impacts in the study area. Impacts include changes to the drying of hydric soils, soil microbial community, reduced riparian and wetland vegetation and increased susceptibility of the soil to erosion. These impacts are within the cumulative effects 10-foot drawdown area that was disclosed and mitigated for in the CIA (BLM 2000b) and Betze SEIS (BLM 2000a, 2003a) as shown in **Figure 3.3-48** and discussed in Section 3.3.3.1.

3.5.3.2 Proposed Action

Cumulative impacts to soils result from surface disturbance related to mining, fire, grazing, farming, recreation, industrial development, roads, municipalities, and other natural and anthropogenic activities within the analysis area.

In addition to mining activities in the CESA, the Newmont TS Power Plant is scheduled to be completed in the first half of 2008 (PR News Wire 2006). A permanent loss of soil productivity is expected in the disturbance area. Soil erosion and mixing may occur during construction.

Municipalities such as Dunphy, Battle Mountain, and Carlin contribute to a decrease in soil quality in the CESA. Typically runoff and erosion increases substantially in compacted areas or on paved surfaces. Soils are often anthropogenically altered in and around municipalities.

Numerous major wildfires have occurred in the study area creating additional regional impacts to soils (BLM 2007b,c). High severity wildfires result in increased water repellent (hydrophobicity) soil, which limits infiltration, combustion and increased mobility of some soil nutrients, mortality of some soil organisms, combustion of surface soil organic matter and loss of effective ground cover that leaves the soil susceptible to erosion and could contribute to noxious weed spread (Korb et al. 2004). Detrimental and severe soil effects can occur down to 10 centimeters (cm) below the surface (Massman et al. 2003). Areas with detrimental soil conditions can persist for decades.

Mining occurs throughout the study area. Mining disturbances include salvage and stockpile of soil for use in reclamation. Growth media excavation, transport and storage, and redistribution would modify existing soil structure, generating adverse impacts relative to aeration and permeability. It is likely that some mixing of textural zones would occur, as well as mixing of inhibitive horizons, such as saline and/or alkaline materials, with growth media. This may create adverse chemical impacts to soil quality for seedbeds. Whatever microbial populations currently exist would likely decrease during growth media stockpiling and storage. Soil erosion may occur before a protective cover crop can be established on stockpiles. Once a cover crop is established, soil erosion would be minimized. Similarly, redistribution of soil during reclamation would leave the soil vulnerable to wind and water erosion. Compaction also may occur during reclamation if repeated passes with heavy equipment occur over growth media.

Mining-related activities have resulted in an estimated 34,000 acres of soil disturbance in the Carlin Trend. The Proposed Action incrementally would increase soil disturbance within the CESA and related impacts by 1,180 acres. It is assumed that portions of past mining-related disturbances have been reclaimed, and ongoing reclamation at existing operations would continue to reduce impacts to soils. The incremental addition of soil impacts as a result of the Proposed Action would be temporary in nature for most of the project facilities, pending completion of successful reclamation. Based on permitting requirements relative to reclamation, it is assumed that the majority of the soil disturbance and associated impacts as a result of future activities also would be reclaimed and temporary.

3.5.3.3 Bazza Waste Rock Facility Alternative

Cumulative impacts to soil resources for the Bazza Waste Rock Facility Alternative would be similar to those described for the Proposed Action except that there would be an incremental decrease in cumulative soil disturbance of 572 acres.

3.5.4 Mitigation Measures and Monitoring

3.5.4.1 Issue

Uncertainties exist about hillslope and drainage parameters at the proposed Clydesdale Waste Rock Facility and whether or not they could be successfully achieved at the proposed site. Long-term site stabilization and the restoration of productive post-mining land uses would require the successful achievement of a satisfactory reclamation design for the proposed facility volume within a proposed footprint.

Recommended Mitigation Measure S-1

BGMI shall prepare a conceptual plan for reclaimed morphometry and hydrology of the Clydesdale Waste Rock Facility and present this plan to BLM for review and approval. This plan will outline and depict how BGMI intends to construct watersheds, hillslopes, and channels that mimic natural conditions, thereby minimizing erosion and promoting long-term stability. BGMI shall use drainage area, basin relief ratios, valley gradients, drainage densities, channel characteristics, and any other useful parameters from comparable nearby landforms to compute and justify watershed characteristics of the proposed facility. This conceptual plan must be approved by BLM before the Waste Rock Facility reaches one-half of its proposed volume. In addition, this conceptual plan must be submitted by January 1, 2009.

Further mitigation will be based on BLM's response to the conceptual Clydesdale plan. If BLM determines that the plan is adequate, no additional mitigation will be required. If the conceptual plan is inadequate, BLM will work with BGMI to reach an acceptable solution. If the solution does not fall within the Proposed Action (e.g., footprint of the facility is not large enough to store proposed waste rock volume), BGMI may be required to conduct additional environmental analysis and submit the appropriate supplemental NEPA documents. The conceptual plan along with any adjustments or additional mitigation must be approved by BLM before the proposed Clydesdale Waste Rock Facility reaches one-half of its proposed volume.

Effectiveness

The additional reclamation design and its implementation for the proposed Clydesdale Waste Rock Facility would mitigate the potential for accelerated erosion and drainage instability to compromise the ET cover and post-mining land uses at that component. Potential adverse impacts to long-term site stability, water quality, wildlife habitat, and visual resources would be avoided or minimized.

3.5.5 Residual Impacts

Residual adverse effects to soils would include a permanent irreversible loss of soil productivity on approximately 129 acres in association with the proposed expansion of the pit, which would be partially backfilled and at closure will slowly fill with water.

3.6 Aquatic Resources

The aquatic resources study area for direct and indirect impacts encompasses the Boulder Creek subbasin. The CESA includes the Maggie Creek subbasin and Antelope Creek drainage (part of Willow Creek subbasin) (**Figure 3.6-1**). The CESA for aquatic biology was defined based on the area that was used in the hydrology modeling analysis. The linkage to the hydrology analysis provided coverage for aquatic biology resources within the area potentially affected by groundwater drawdown for cumulative actions. The types of information used to characterize aquatic resources consist of habitat and distribution/occurrence information for fish, amphibian, and invertebrate species or groups. This discussion focuses on new or updated information available since the Betze Project Draft and Final SEIS (BLM 2000a, 2003a).

3.6.1 Affected Environment

3.6.1.1 Habitat and Aquatic Biology Resources

Boulder Creek Subbasin

Aquatic habitat in the Boulder Creek subbasin consists mostly of intermittent and ephemeral channels that are part of Rodeo, Bell, Brush, and Boulder creeks (**Figure 3.6-1**). Portions of Brush Creek have been dry since 1994 as a result of mine dewatering (Adrian Brown Consultants 1999; AATA 2006). Habitat conditions and aquatic communities are assumed to be similar to descriptions provided in the Betze Project Draft and Final SEIS (BLM 2000a, 2003a), because no channel modifications or management changes have been implemented during the past 4 years with the exception of the Brush Creek diversion channel. Habitat quality was rated as poor in the lower and middle portions of these streams as a result of relatively low flows, grazing, and erosion (JBR 1994). Perennial stream sections exist in upper Boulder Creek where moderate quality habitat is present. Previous sampling in the subbasin has collected Lahontan speckled dace (*Rhinichthys osculus robustus*) in areas where water is present on a fairly consistent basis. Macroinvertebrate sampling in these streams revealed a low number of taxa (3 to 16) that were tolerant of limited habitat conditions (JBR 1994, 1992b). The most abundant taxa included chironomid midges, elmid beetles, and ostracods. The headwater areas of Boulder Creek contain a more diverse and abundant macroinvertebrate community as a result of more persistent flow and higher quality habitat.

Willow Creek and Rock Creek Subbasins

Two tributaries, Antelope Creek (Rock Creek Subbasin) and Willow Creek (Willow Creek Subbasin), are located north of the Betze Mine. Antelope Creek is an intermittent stream that drains much of the area west of the Sheep Creek Range. Six monitoring spring sites have been monitored in this drainage (AATA 2006). Consistent annual flow was observed only at two of the springs located in the headwaters of the drainage. Due to the intermittent nature of Antelope Creek, fish habitat is limited, although they have been observed in Antelope Creek where the road from Rossi Mine to the Hollister Mine crosses the creek. The only aquatic surveys performed have focused on springsnails, which are discussed in Section 3.6.1.2.

Aquatic habitat has been characterized at three monitoring sites in Upper Willow Creek between Willow Creek Reservoir and upper portions of the drainage as part of Barrick's UWCHEP. This monitoring plan was established in 2003 in Nelson, Lewis, and Willow creeks to mitigate potential direct, indirect, and cumulative effects identified in the Betze SEIS. The UWCHEP includes pasture fencing and prescription grazing with benefits for 20 miles of aquatic habitat and over 12,000 acres of upland acres. Recent surveys in 2006 have shown improvements in riparian and stream habitat conditions (Cedar Creek Associates 2007b). Streambank conditions at the three Willow Creek monitoring sites were characterized has having stable streambanks (58 to 93 percent of optimum conditions) and moderately developed vegetative cover (55 to 75 percent of optimum conditions) (Cedar Creek Associates 2007b). Fish communities are expected to be similar to perennial sections of upper Boulder Creek.

Maggie Creek Subbasin

Based on studies conducted in 1987 through 1997, aquatic habitat and fish and invertebrate communities in the Maggie Creek subbasin were described in the Betze Project Draft and Final SEIS (BLM 2000a, 2003a) (**Figure 3.6-1**). The following information provides a summary of aquatic resources in this subbasin with emphasis on studies conducted since 1997.

Diverse aquatic habitat conditions are present in the Maggie Creek subbasin. The lower reaches of tributary streams such as Little Jack, Coyote, and Lynn creeks often dry up during the summer months. In contrast, the headwaters of Little Jack, Coyote, and Simon creeks and the wet-meadow areas along lower Coyote and Little Jack creeks exhibit stable vegetated channels with higher volumes in the summer months. The following mitigation and monitoring plans have resulted in improved habitat conditions in this subbasin:

- Maggie Creek Watershed Restoration Project Monitoring Program (included in 1993 and 2002 SOAP and SOAPA mitigation plans). Studies by Open Range Consulting (2007) showed an increase of 193 acres of wetland riparian vegetation and a 1.8-mile increase in stream length (due to additional stream sinuosity) along Maggie Creek between 1994 and 2006. Sediment loading has been reduced by more than 8,000 tons per day (expressed as total suspended solids) during similar flow conditions in 2005. Habitat quality improved as a result of increased woody riparian vegetation (overhanging cover), improved pool quality, and depth at the shore-water interface (Trout Unlimited 2007).
- Mitigation Plan for the 2002 Leeville Project: A conservation easement was extended for the Maggie Creek Watershed Restoration Project.

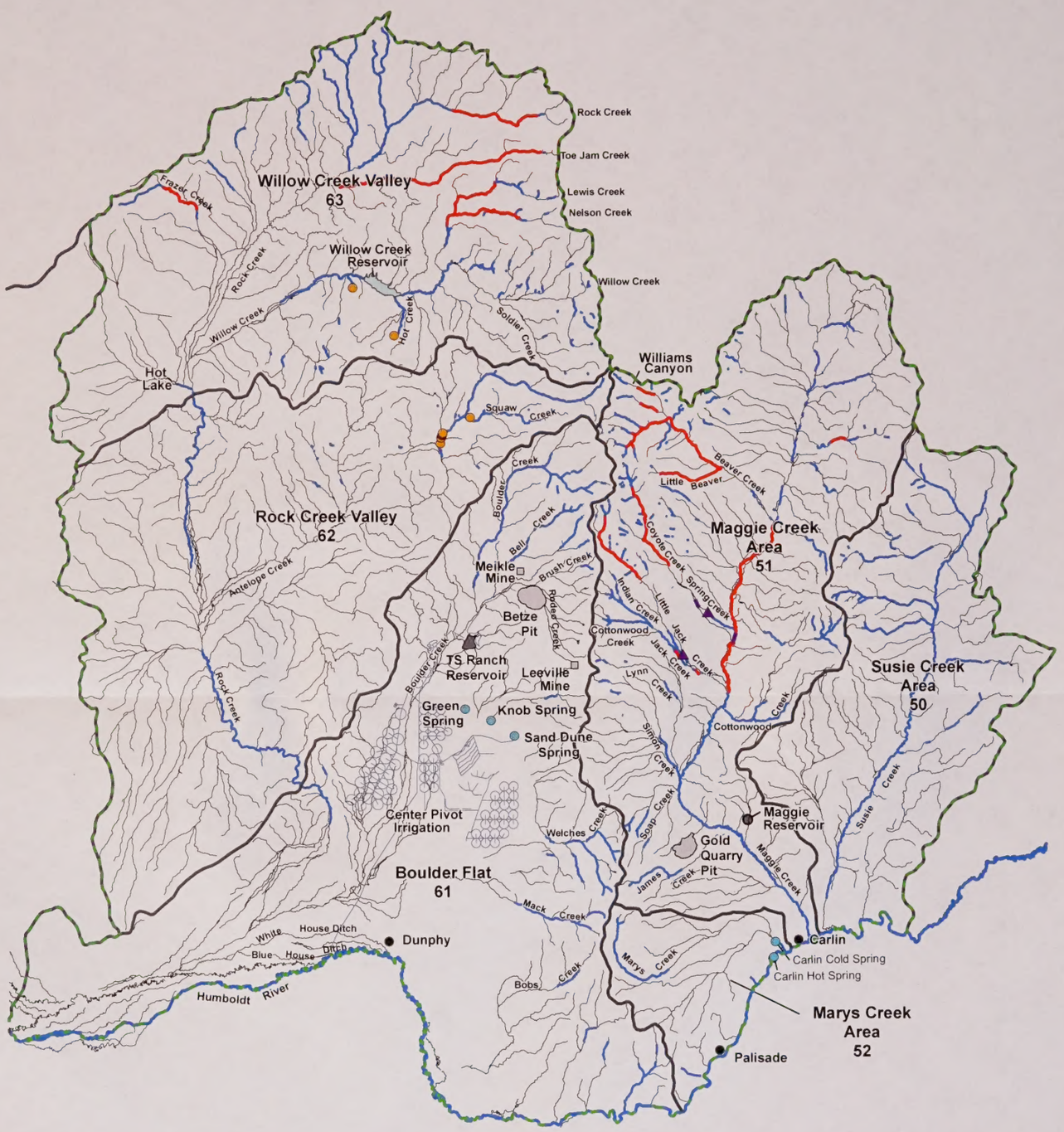
Habitat surveys have been conducted by the BLM in portions of the Maggie Creek subbasin between 2000 and 2006 (BLM Elko Field Office Files, as cited in BLM 2007b). The studies showed the following condition ratings based on an average bank cover and bank stability in relation to optimum conditions: poor (James and Indian Jack creeks), good (Maggie and Susie creeks), and excellent (Coyote and Little Jack creeks and the Beaver Creek drainage). Flooding in 2005 and 2006 caused widespread erosion in the subbasin, but the streams with good and excellent condition ratings have recovered to pre-flood habitat quality (BLM 2007b).

Fish communities in the Maggie Creek subbasin mainly consist of a mixture of trout, sucker, and minnow species (**Table 3.6-1**). Speckled dace represented the most common and widespread species. LCT is the only trout species presently occurring in the Maggie Creek subbasin. Previous surveys have collected brook trout in Spring Creek (tributary to Coyote Creek), but none were found in 1997 (BLM 2007b). Additional information for LCT, a federally listed species, is provided in the Special Status Species section. The remaining game fish species present in this subbasin is smallmouth bass (*Micropterus dolomieu*), which was collected in lower Maggie Creek in 2006 and 2007 (MFG, Inc. 2006 as cited in BLM 2007b).

Macroinvertebrate communities in the Maggie Creek subbasin reflect variable abundance and composition depending on habitat conditions. In most instances, moderately diverse and productive communities were reported in the headwater portions of tributary streams (JBR 1992c; AATA 1998, 1997). Macroinvertebrate composition in the headwater areas of the subbasin streams also contained taxa that were indicators of good water quality conditions. The most abundant taxa included mayflies, caddisflies, Diptera, midges, and amphipods. The middle and lower portions of the streams were dominated by pollution-tolerant taxa such as chironomid midges, oligochaete worms, blackfly larvae, and mayflies (*Baetis* spp.).

3.6.1.2 Special Status Species

Special status species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed species that are protected under the Endangered Species Act (ESA), species of concern as identified by the U.S. Fish and Wildlife Service (USFWS), and species designated as state sensitive by the BLM. Nevada State protected lists are provided by NDOW (2007a).



3.6-3

Figure 3.6-1

Current Distribution of Lahontan Cutthroat Trout, Spotted Frogs, and Springsnails Occurrence

Betze Pit Expansion Project

LEGEND

- Lahontan Cutthroat Trout
- Spotted Frog Potential Habitat
- Spotted Frog Collection Sites
- Springsnail Locations
- Lahontan Cuttthroat Trout, Spotted Frogs, and Springsnails Cumulative Effects Study Area
- Groundwater Basin Boundary
- Perennial Stream Reach
- Stream (Intermittent or Ephemeral)

Note: USGS 2007 line graph database. Hydrographic Area Boundary locations are approximate.

Source: BGMI 2007a; BLM 2000a.

N

0 5 10 Miles

05/20/2008

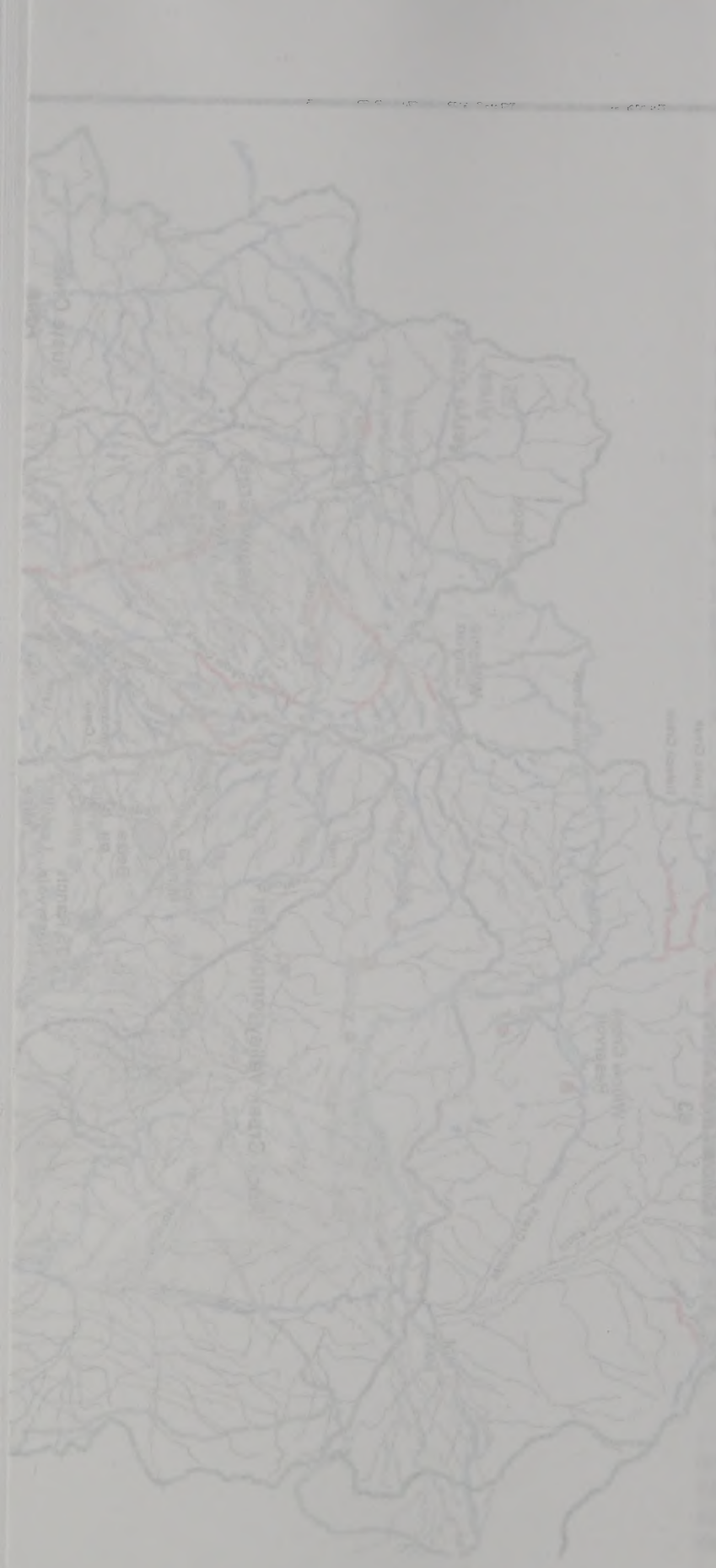


Table 3.6-1 Fish Species in Maggie Creek Subbasin

Common Name	Scientific Name	Drainage									
		Buck Rake Jack	West Cottonwood	Coyote	Indian	Jack	Little Jack	Maggie	Lone Mountain Creek (Maggie Creek Headwaters)	Beaver Creek Drainage	Susie
Lahontan cutthroat trout	*Oncorhynchus clarki henshawi*	–	–	X	–	–	X	X	X	–	–
Lahontan redside shiner	*Richardsonius balteatus*	–	–	–	–	–	X	X	–	X	X
Lahontan speckled dace	*Rhinichthys osculus*	X	X		X	X	X	X	–	X	X
Mountain sucker	*Catostomus platyhynchus*	–	–	–	–	–	–	X	–	–	X
Smallmouth bass	*Micropterus dolomieu*	–	–	–	–	–	–	X	–	–	–
Tahoe sucker	*Catostomus tahoensis*	–	–	–	–	–	–	–	–	X	–

Source: BLM 2007b; JBR 1992c; AATA 1997; Valdez et al. 1994.

In accordance with the ESA, as amended, the lead agency (BLM) in coordination with the USFWS must ensure that any action that they authorize, fund, or carry out would not adversely affect a federally listed threatened or endangered species. In addition, as stated in Special Status Species Management Policy 6840 (6840 Policy) (Rel. 6-121), it also is BLM policy "to conserve listed species and the ecosystems on which they depend, and to ensure that actions requiring authorization or approval by the BLM are consistent with the conservation needs of special status species and do not contribute to the need to list any special status species, either under the provisions of the ESA or other provisions" identified in 6840 Policy. The BLM has engaged in discussions with the USFWS.

Five species or groups of special status aquatic species were evaluated for potential occurrence within the study area and CESA. These include one federally listed fish species (LCT), one federal candidate amphibian species (Columbia spotted frog), one state protected and BLM sensitive amphibian (northern leopard frog), one BLM sensitive mollusk species (California floater), and one group of special concern mollusks (springsnails). The potential occurrence and habitat requirements are discussed below for these species.

Fish Species

Lahontan Cutthroat Trout

Detailed information on LCT distribution, abundance, and habitat use of the Maggie Creek subbasin is provided in the Betze Project Draft and Final SEIS (BLM 2000a, 2003a). The following discussion focuses on LCT studies that have been conducted since the Betze Project SEIS. The present distribution of LCT within the Maggie Creek subbasin is limited to the following streams: Little Jack Creek, Jack Creek, Coyote Creek, Beaver Creek, Little Beaver Creek, Toro Canyon, Williams Canyon, mainstem Maggie Creek, and Lone Mountain Creek (**Figure 3.6-1**). In total, approximately 94 miles of potential LCT habitat occurs within this subbasin (Elliott 2004). The distribution of LCT has expanded in Maggie Creek and three of its tributaries (Little Jack, Coyote, and Beaver creeks), as a result of replacing three road culverts and an irrigation diversion in 2005 (Neville and DeGraaf 2007). These perched culverts were known to inhibit but not totally prevent movement of LCT populations between the various streams. The goal of the restoration program is to reconnect these local populations into a metapopulation.

Abundance estimates for LCT were initiated at 44 monitoring sites in Little Jack, Coyote, and Beaver creeks (Neville and DeGraaf 2007). Numbers have fluctuated in these tributaries as a result of environmental factors and restoration practices. Environmental factors that have affected LCT abundance in recent years have included a large fire in 2001 and drought in 2004. LCT population count estimates in 2006 included 378 in Beaver Creek, 141 in Coyote Creek, and 451 in Little Jack Creek. Additional population and tagging studies are proposed to determine if the restoration efforts are re-establishing a connected metapopulation.

LCT spawning typically occurs in April through July depending on stream conditions including flow, water temperature, and elevation (Coffin and Cowan 1995). Spawning habitat consists of gravels in riffle areas. The presence of young-of-the-year fish in Little Jack, Coyote, and Beaver creeks has shown successful spawning in recent years (Neville and DeGraaf 2007).

Amphibians

Columbia Spotted Frog

The Columbia spotted frog occurs in wetland habitats, streams, or springs during the breeding season (**Figure 3.6-1**). After the breeding season is completed, they may move considerable distances to upland areas in grassland, shrub, and forest communities (BLM 2000a, 2003a). The potential occurrence of Columbia spotted frog in the study area is discussed in the Betze Project Draft and Final SEIS (BLM 2000a, 2003a). The entire upper Humboldt watershed is considered potential habitat. Columbia Spotted frog has not been observed in the Boulder Valley area. It has been collected in Coyote and Little Jack creeks in the Maggie Creek subbasin.

The Columbia spotted frog occurs primarily in Central Nevada (Nye County) and northeastern Nevada (Elko and Eureka counties), usually at elevations between 5,600 and 8,700 feet (USFWS 2007a). This species prefers quiet aquatic habitats including perennial streams, ponds, springs, lakes, and marshes (USFWS 2007a). The Columbia spotted frog may travel to uplands during wet weather, expanding localized populations. Females begin laying eggs in late April and May, and tadpoles emerge by August. This species has not been documented within or near the study area. The nearest known population is located east of the study area along Maggie Creek, lower Coyote Creek, and lower Little Jack Creek (BLM 2002a). Although previous surveys have not observed this species within the study area, there is marginal habitat along Boulder Creek. The potential for this species to occur within the study area is considered moderate.

Northern Leopard Frog

The northern leopard frog is broadly distributed in limited and isolated habitats from eastern Nevada to northern and western Nevada. Most Nevada populations are highly localized and isolated from one another (Wildlife Action Plan Team [WAPT] 2006). This species inhabits permanent water with rooted aquatic vegetation such as springs, slow streams, marshes, bogs, ponds, canals, flood plains, reservoirs, and lakes (WAPT 2006). In summer, the northern leopard frog commonly inhabits wet meadows and fields. This species takes cover underwater, in damp niches, or in caves when inactive. Eggs are laid and larvae develop in shallow, still, permanent water (typically), generally in areas well exposed to sunlight (WAPT 2006). Eggs are typically attached to vegetation just below the surface of the water. Females begin laying eggs in late April and May, and tadpoles emerge by August. Marginal habitat for this species occurs along Boulder Creek on the far western edge of the study area. The potential for this species to occur within the study area is considered moderate.

Mollusks

Springsnail Species

Springsnails, a group of mollusks that are found in perennial springs and seeps, are considered important organisms due to their restricted distribution and native origin. As a result of taxonomic identification difficulties at the species level, most of the records are genus level. The most common genus in the general area is *Pyrgulopsis*. Springsnails usually inhabitat spring sources or wetted areas located immediately downstream of

the source. Other habitat characteristics include low to moderate discharges, stable substrates consisting of gravel, cobble or boulders, and dense aquatic vegetation (McGuire 1996, 1992).

Springsnails have been collected from a limited number of locations within the study area (**Figure 3.6-1**). Based on surveys conducted by McGuire (1995, 1996 as cited in BLM 2003a), springsnails were collected in eight of 41 springs in the study area. None of these sites are located within the Boulder Valley subbasin. The closest springs with known springsnail populations are located in the Antelope and Squaw creek drainages, which are situated in the Rock Creek Valley groundwater basin. Springsnail populations also have been recorded at sites in the Maggie Creek subbasin in Willy Billy Spring and Warm Spring near the Humboldt River (McGuire 1992, as cited in BLM 2000b).

California Floater

Recent records for the freshwater mussel, California floater, are limited to Rock Creek Canyon (lower and middle canyon sections) and the mainstem of Maggie Creek (Evans 2008). No habitat or individuals have been observed in the Boulder Valley subbasin. No additional specimens or habitat have been identified since surveys conducted by McGuire (1995 as cited in BLM 2003a). Habitat at collection sites in Nevada primarily have consisted of small permanent streams with pools or runs and varying substrates.

3.6.2 Environmental Consequences

The primary issues related to aquatic resources include:

- Loss or changes in existing aquatic habitat; and
- Potential impacts to special status species.

3.6.2.1 No Action Alternative

Under the No Action Alternative, project activities that would affect aquatic communities include:

- Surface disturbance activities in the mine area;
- Diversion of Rodeo Creek; and
- Continuation of mine dewatering through 2015 under the current mine plan.

These activities would cause impacts only to the Boulder Creek subbasin. The Antelope Creek area would sustain impacts only from dewatering. Impacts associated with each type of activity are discussed below.

Surface disturbance activities would involve vehicle traffic and mining activities at the existing waste rock dump, Betze Pit, and tailings facilities. Culverts would be constructed on Bell Creek. These activities would generate soil disturbance within the drainages for Bell, Rodeo, and Brush creeks. By implementing engineering design and BMPs for erosion control, sediment input to these intermittent streams would be minor. Construction activities also would involve a reroute of Rodeo Creek, which is not an action involving BLM authorization. A 3.8-mile segment of the stream would be removed and replaced with a new 2.3-mile segment that would direct flow around the southern portion of the Betze Pit. The new channel would be earthen material with a liner. The reroute would result in a temporary loss of aquatic habitat for Lahontan speckled dace and macroinvertebrates in Rodeo Creek. After the new stream segment is established, dace and invertebrates likely would recolonize the stream. The net effect of the reroute would be a reduction of approximately 1.5 miles of intermittent stream habitat.

Aquatic communities such as algae, plankton, vascular plants, benthic macroinvertebrates, and possibly fish could eventually develop in the current mine plan pit lake. Populations are expected to remain low and not represent a substantial food source (BLM 2000a).

The mitigation specified in the Betze Project SEIS (BLM 2003a) addressed all direct, indirect, and cumulative impacts within the projected maximum cumulative 10-foot drawdown contour (**Figure 3.3-48** and **3.6-2**). Therefore, the 2007 groundwater model results show that there are no new impacts to aquatic resources as a result of dewatering.

3.6.2.2 Proposed Action

The Proposed Action activities that would affect aquatic communities include the diversion of Rodeo Creek into the pit lake at mine closure and surface disturbance activities in the mine area. These activities would be limited to the intermittent sections of Boulder and Bell creeks within the mine area. No dewatering would occur as part of the Proposed Action.

The diversion of Rodeo Creek into the pit lake (which may occur in both the Proposed Action and No Action Alternative as described in Section 2.2.1.12) would occur after mining is completed in 2016. This action would require a State of Nevada decision with no BLM authorization. Stream rerouting would result in a short-term loss of intermittent stream habitat that currently exists in the mine area. It is assumed that the reroute would remove approximately half of the 2.3-mile section of Rodeo Creek. A new section of Rodeo Creek would be constructed to connect with the pit lake. Within 1 year, macroinvertebrates would begin recolonizing the manmade channel. Lahontan speckled dace also could utilize the new channel. The occurrence and distribution of dace would be related to the frequency of flow events. Due to the intermittent nature of the channel, no consistent habitat would be available for aquatic species.

The input of water via Rodeo Creek to the pit lake would improve water quality conditions in the lake through additional dilution of pit lake water. Although this change would be beneficial to aquatic organisms expected to colonize the lake, it would likely not alter the abundance or diversity of macroinvertebrates. The overall lack of shallow shoreline areas would be the key factor contributing to the predicted low production in the lake in terms of macroinvertebrate and macrophyte communities. Some macrophyte and macroinvertebrate communities may develop in the southeast portion of the pit where water will not be as deep due to backfill.

Due to the intermittent nature of the source water (Rodeo Creek), the potential introduction of Lahontan speckled dace would be limited. If fish were washed into the pit lake, the overall habitat would not be conducive to the development of productive dace populations.

Surface disturbance activities associated with vehicle traffic and mining activities would occur at the proposed Clydesdale Waste Rock Facility and Betze Pit. These activities would generate soil disturbance within the drainages for Bell and Rodeo creeks. By implementing BMPs for erosion control, sediment input to these intermittent streams would be minor.

After mining is completed, a pit lake would begin filling in Year 14. Since the lake would contain steep banks and lack shallow bays or shoreline areas (except on the southeast portion of the pit), overall biological productivity is expected to be low. Macroinvertebrate communities would colonize the bottom substrates, but their diversity in terms of the number of taxa is expected to be low due to depths and lack of shallow shoreline areas except in the southeast portion of the pit. Aquatic macrophyte (large-size) plant growth likely would be limited for the same reasons.

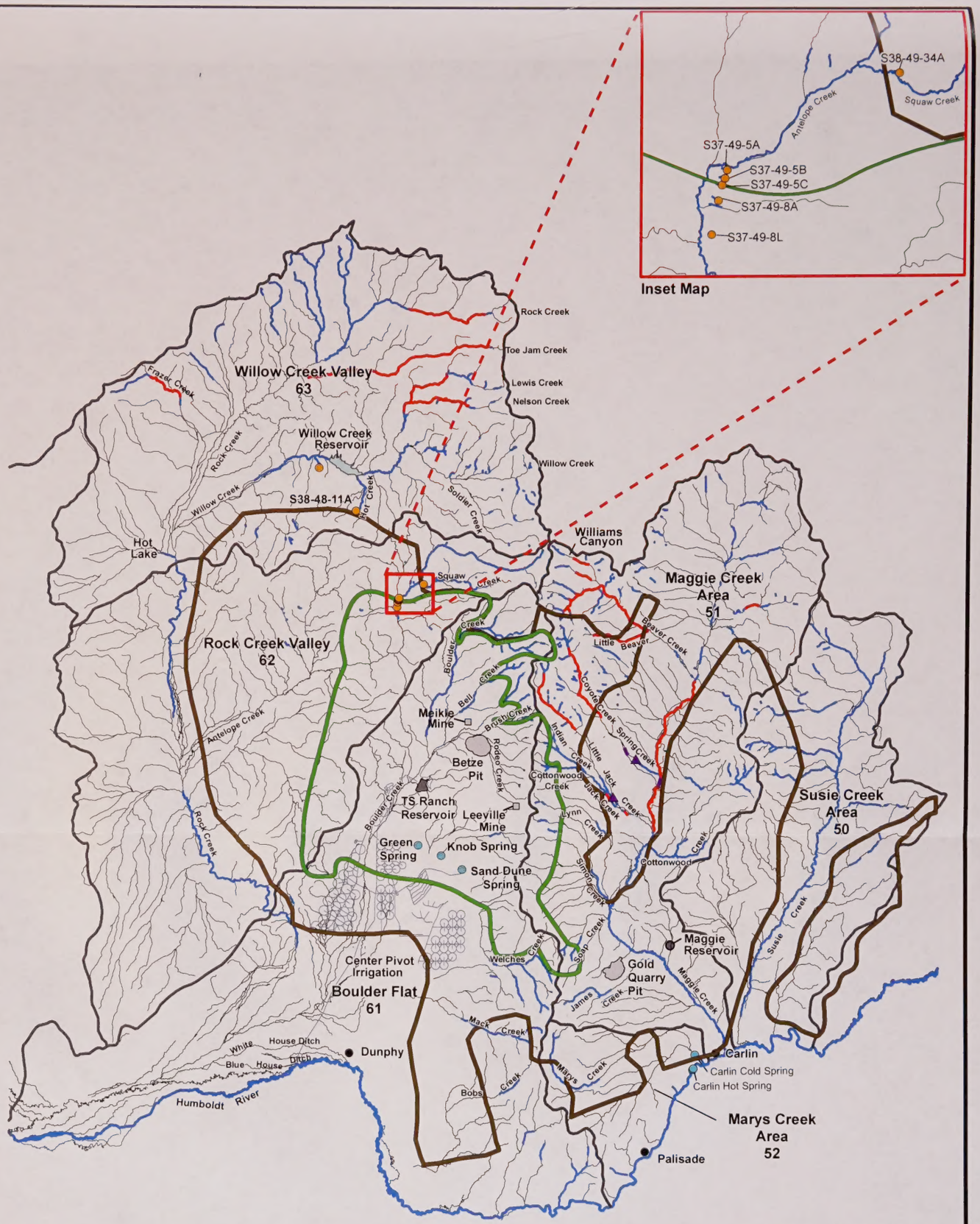
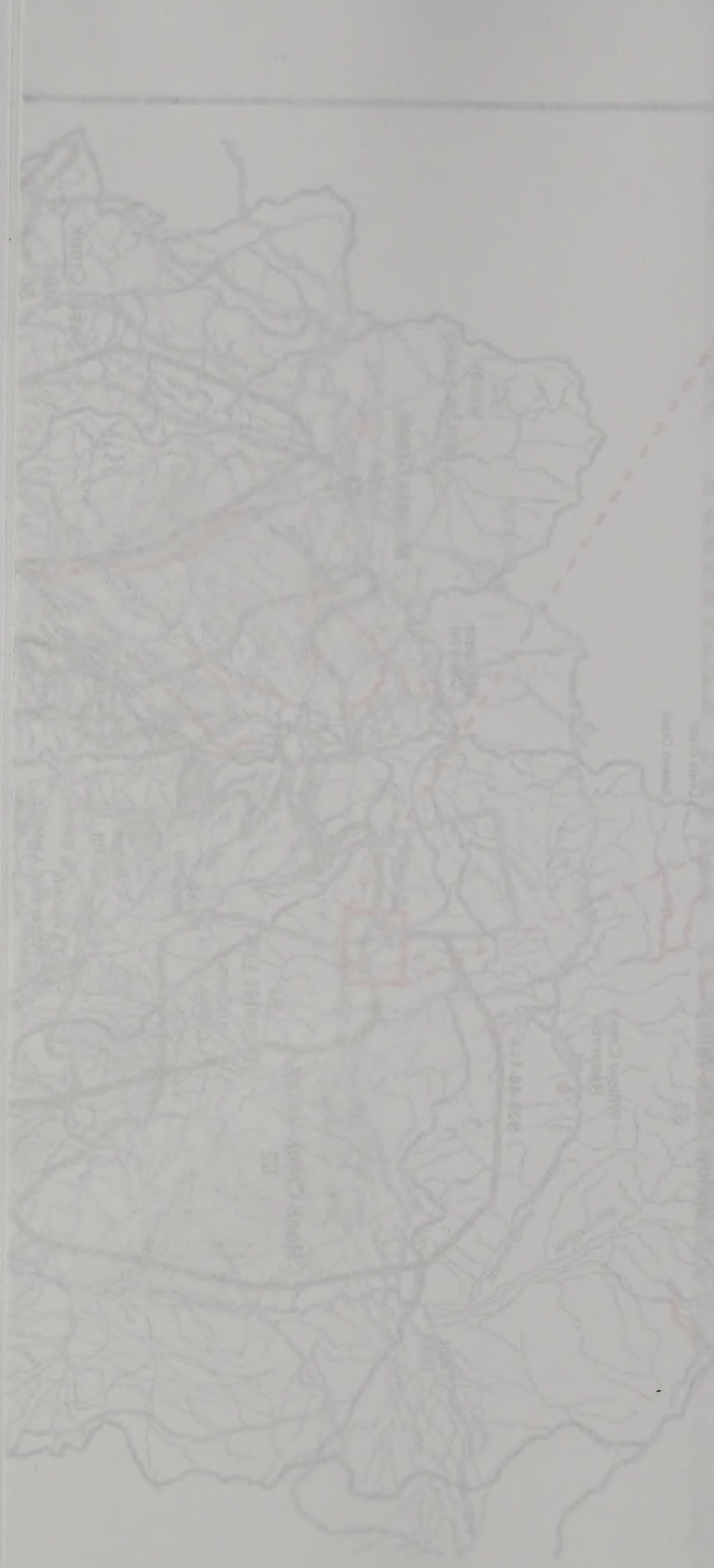


Figure 3.6-2

Predicted Maximum Drawdown (at 100 years post-mining) Direct Impacts in Relation to Lahontan Cutthroat Trout, Spotted Frogs, and Springsnails Occurrence

Betze Pit Expansion Project

06/04/2008



3.6.2.3 Bazza Waste Rock Facility Alternative

The Bazza Waste Rock Facility Alternative would result in the same impacts to aquatic resources as described for the Proposed Action.

3.6.3 Cumulative Impacts

The CESA for aquatic resources is shown in **Figure 3.6-1**. Past and present actions and RFFAs are identified in Section 3.1.

3.6.3.1 No Action Alternative

Based on the model predictions for cumulative impact scenarios (**Figure 3.6-3**), surface water flows or water levels could be affected in the Boulder Creek subbasin and Antelope Creek drainage. Aquatic resources that would be affected by surface water reductions include native fish species, macroinvertebrates and springsnails.

The maximum cumulative 10-foot drawdown (**Figure 3.6-3**) would extend and overlap with a portion of Antelope Creek. Drawdown could affect one known springsnail location in the Antelope Creek drainage. The springsnail spring location on Squaw Creek is just outside the 2000 Model maximum cumulative 10-foot drawdown contour. However, adequate mitigation for potential impacts to that springsnail location was provided in the 2003 SEIS (BLM 2003a).

3.6.3.2 Proposed Action

The Proposed Action would result in relatively minor effects on aquatic resources in the Boulder Creek drainage. Therefore, the Proposed Action would not contribute to cumulative impacts on aquatic resources.

3.6.3.3 Bazza Waste Rock Facility Alternative

This alternative would not contribute to cumulative impacts on aquatic resources.

3.6.4 Mitigation Measures and Monitoring

Existing monitoring would continue in the Boulder Creek Subbasin and Antelope Creek. The Boulder Valley Monitoring Plan monitors stream flows and springs in the Boulder Creek drainage and Antelope Creek as part of the Betze EIS (BLM 1991a,b). An additional monitoring location was installed on Antelope Creek, as described in the Appendix A of the Betze SEIS (BLM 2003a). Springs in Upper Boulder Creek, Antelope Creek, and upper Bell Creek also are being monitored to detect changes in water levels and outflows and water quality (AATA 2006, 2007). As discussed in Section 3.3, Groundwater Resources and Geochemistry, monitoring results have not indicated effects from dewatering.

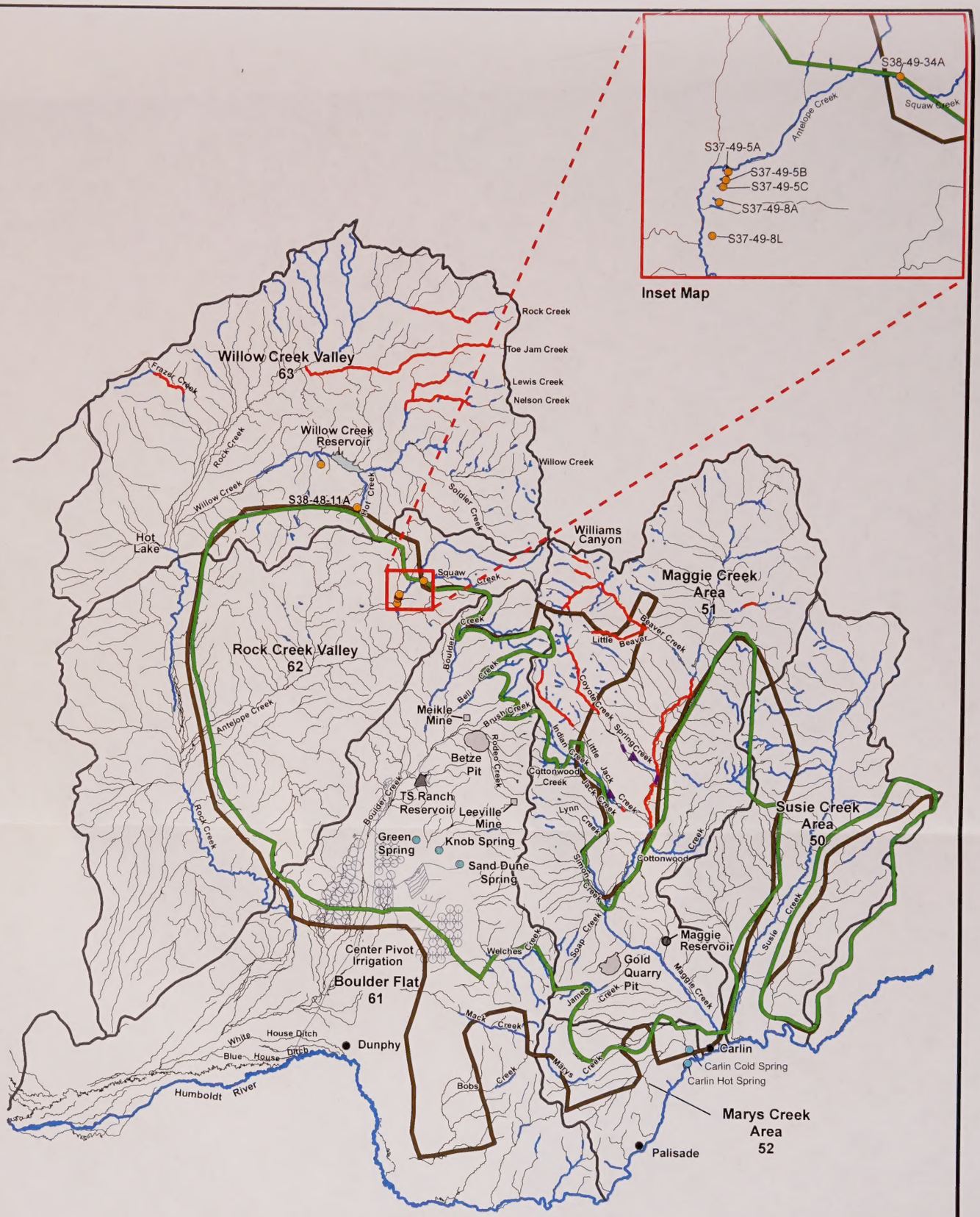
An ongoing monitoring program also exists in the Maggie Creek Subbasin, as described in the Leeville and SOAPA Cumulative Effects SEIS (BLM 2007b,c). Monitoring sites have been established in streams inhabited by LCT (Jack, Little Jack, Coyote, and Beaver creeks and numerous springs. Monitoring results have not indicated effects on stream segments or springs in the Maggie Creek Subbasin with the exception of Maggie Creek at the Narrows (BLM 2002b; Newmont 2007).

Existing mitigation for the Boulder Creek Subbasin, Antelope Creek, and Maggie Creek Subbasin have focused on improving riparian vegetation and aquatic habitat. The UWCHEP was implemented to improve riparian, aquatic, and upland habitat along 20.5 miles of stream in the Upper Willow Creek watershed as part of mitigation for the Betze Project SEIS (BLM 2003a). In addition, the Long-term Monitoring and Mitigation Fund was established by BGMI to mitigate unanticipated impacts to the environment, including biological resources, from the Betze Project (BLM 1991b). This trust fund would be sufficient to mitigate for unanticipated impacts to aquatic resources. No monitoring or mitigation is recommended for the Proposed Action because

impact levels are considered to be included in the 2000/2003 SEIS (BLM 2000a, 2003a) for which mitigation has already been implemented. No additional mitigation is considered necessary or appropriate.

3.6.5 Residual Impacts

No residual impacts on aquatic biology resources would occur as a result of the Proposed Action, No Action Alternative, or Bazza Waste Rock Facility Alternative, unless the dewatering 10-foot drawdown contour (No Action Alternative) affects the springs on Antelope Creek to such an extent that flow rates become too low to support resident springsnail populations. As each population is specific to a spring source, extensive flow reduction or springs drying up would cause an irretrievable loss of the specific springsnail population.



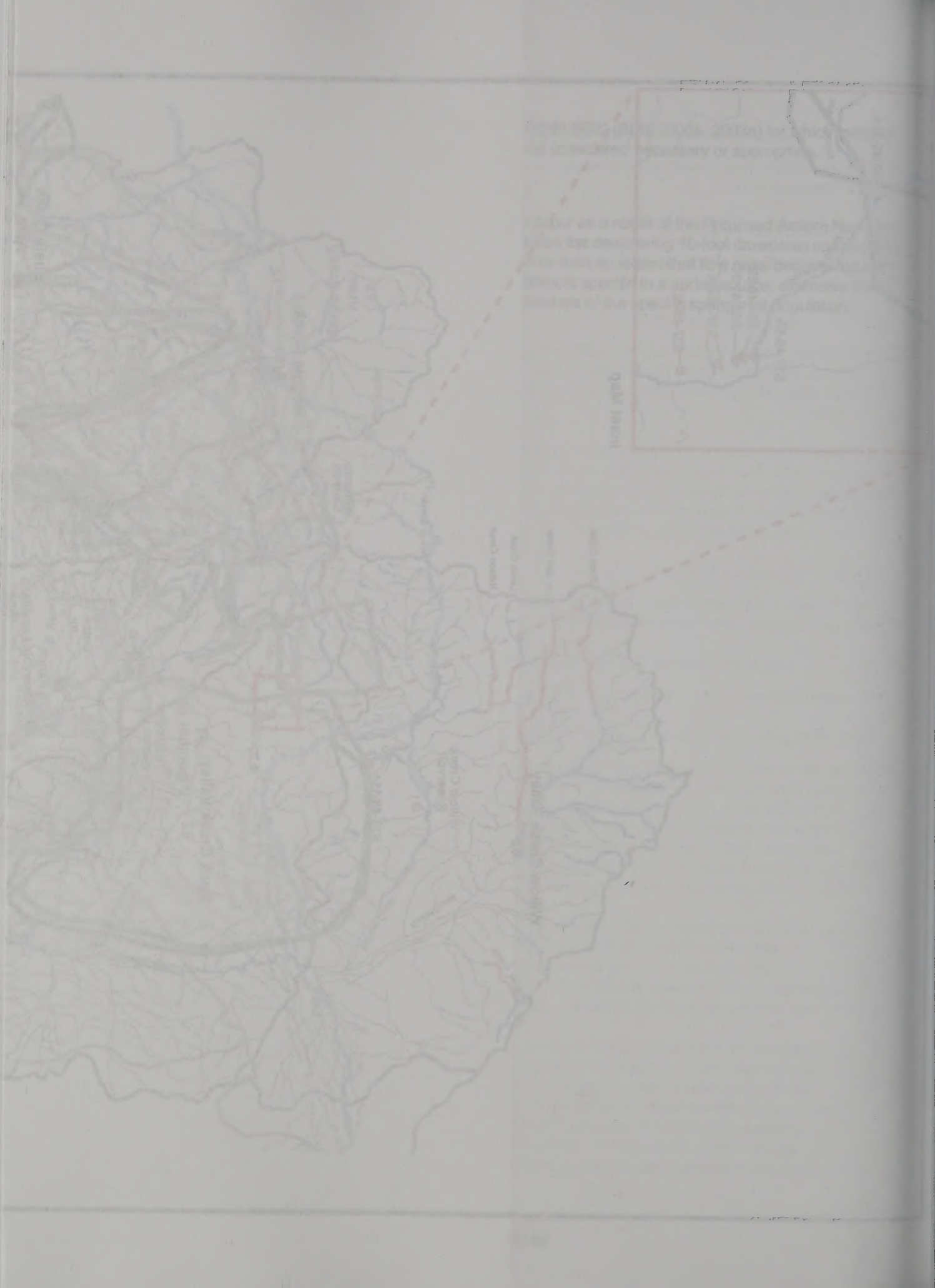
Predicted Maximum Extent of 10-foot Cumulative Drawdown in Relation to Lahontan Cutthroat Trout, Spotted Frogs, and Springsnails Occurrence

Figure 3.6-3

Betze Pit Expansion Project

3.6-11

06/04/2008



3.7 Vegetation Resources

The vegetation resources study area for direct and indirect impacts encompasses the proposed project boundary (**Figure 3.7-1**). The CESA was chosen to encompass the project boundary, surface disturbance associated with existing activities, riparian and/or wetland habitats within the modeled cumulative 10-foot groundwater drawdown area, and RFFAs within the Carlin Trend (**Figure 3.7-2**).

3.7.1 Affected Environment

3.7.1.1 Upland Vegetation

The study area is located entirely within the Boulder Flat Watershed Subbasin floristic region. This region is characterized by large, extensive valleys located between two mountain ranges: the Tuscarora Mountain Range to the north of Boulder Flat and the Sheep Creek Range to the southwest.

Vegetation cover types, acreage calculations, and community characterizations were compiled based on aerial interpretation, Southwest Regional GAP (SWReGAP) Analysis Project Land Cover analysis and site characterizations, along with the results of site-specific vegetation studies conducted in 1995 and 1994 for the 2000 Betze Project SEIS (BLM 2000a, 2003a; USGS 2004; Whitehorse Associates 1995; JBR 1994). These studies included the delineation of plant communities based on aerial photograph interpretation and on-site vegetation analysis. Vegetation assessments were completed within these plant communities to determine plant composition and to estimate foliar cover, forage production, and other vegetation parameters.

Three vegetation cover types and two land use cover types are located in the study area. The vegetation cover types include salt-desert shrubland, sagebrush shrubland, and grassland habitats. The land use cover types include developed lands (i.e., industrial/commercial) and barren lands. Distribution of vegetation cover types in these areas is strongly influenced by variations in landscape position, soil type, moisture, elevation, and aspect. Descriptions of the plant communities in each of these vegetation cover types are provided in the following text. Species nomenclature herein is consistent with the USDA NRCS Plants Database (USDA NRCS 2007b). **Figure 3.7-1** illustrates the vegetation cover types present within the vegetation resources study area. **Table 3.7-1** summarizes acreages for each vegetation cover type within the vegetation study area.

Table 3.7-1 Vegetation Cover Types within the Study Area[1]

Vegetation Cover Type	Acres
Sagebrush Shrubland	3,135.3
Grassland	34.1
Salt-desert Shrubland	19.1
Riparian/Wetland	0.0
Industrial/Commercial	7,029.1
Barren	2.6
Total	**10,220.2**

[1]Vegetation cover types were compiled based on USGS SWReGAP data. As such, spatial limitations are attributed to this data set since it was collected on a regional landscape level. Note that this data (i.e., vegetation cover types and their associated acreages) are approximate.

Source: USGS 2004.

Sagebrush Shrubland

The most dominant community within the study area, sagebrush shrubland, is characterized as a lower elevational basin community of the Great Basin and Inter-Mountain Basin ecoregions. This land use cover type comprises 31 percent of the mine operations boundary. Soils are typically deep, well-drained, and non-saline. These shrublands are dominated by Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), rubber rabbitbrush (*Ericameria nauseosa*), yellow rabbitbrush (*Chrysothamnus viscidiflorus*), greasewood (*Sarcobatus vermiculatus*), juniper species (*Juniperus* spp.), and saltbush species (*Atriplex* spp.). The herbaceous component, composed of Indian ricegrass (*Achnatherum hymenoides*), blue grama (*Bouteloua gracilis*), thickspike wheatgrass (*Elymus lanceolatus*), Idaho fescue (*Festuca idahoensis*), Sandberg bluegrass (*Poa secunda*), needle-and-thread grass (*Hesperostipa comata*), and Great Basin wildrye (*Leymus cinereus*), contributes less than 25 percent to this community (USDA NRCS 2007b; USGS 2004).

Grassland

This minor vegetation cover type is characterized as Inter-Mountain Basin Semi-Desert Grassland occurring on dry plains and mesas. This community occurs in lowland and upland areas and may occupy swales, playas, mesatops, plateau parks, alluvial flats, and plains. Sites are typically xeric. Substrates are often well-drained sandy or loamy-textured soils derived from sedimentary parent materials but are quite variable and may include fine-textured soils derived from igneous and metamorphic rocks. Dominant perennial bunchgrasses and shrubs within this vegetation cover type are all very drought-resistant species and may include Indian ricegrass, three-awn (*Aristida* spp.), blue grama, needle-and-thread grass, muhly species (*Muhlenbergia* spp.), and galleta grass (*Pleuraphis jamesii*), as well as scattered shrub and dwarf-shrub species such as sage, saltbush, Mormon tea (*Ephedra nevadensis*), broom snakeweed (*Gutierrezia sarothrae*), and winterfat (*Krascheninnikovia lanata*) (USDA NRCS 2007b; USGS 2004).

Salt-desert Shrubland

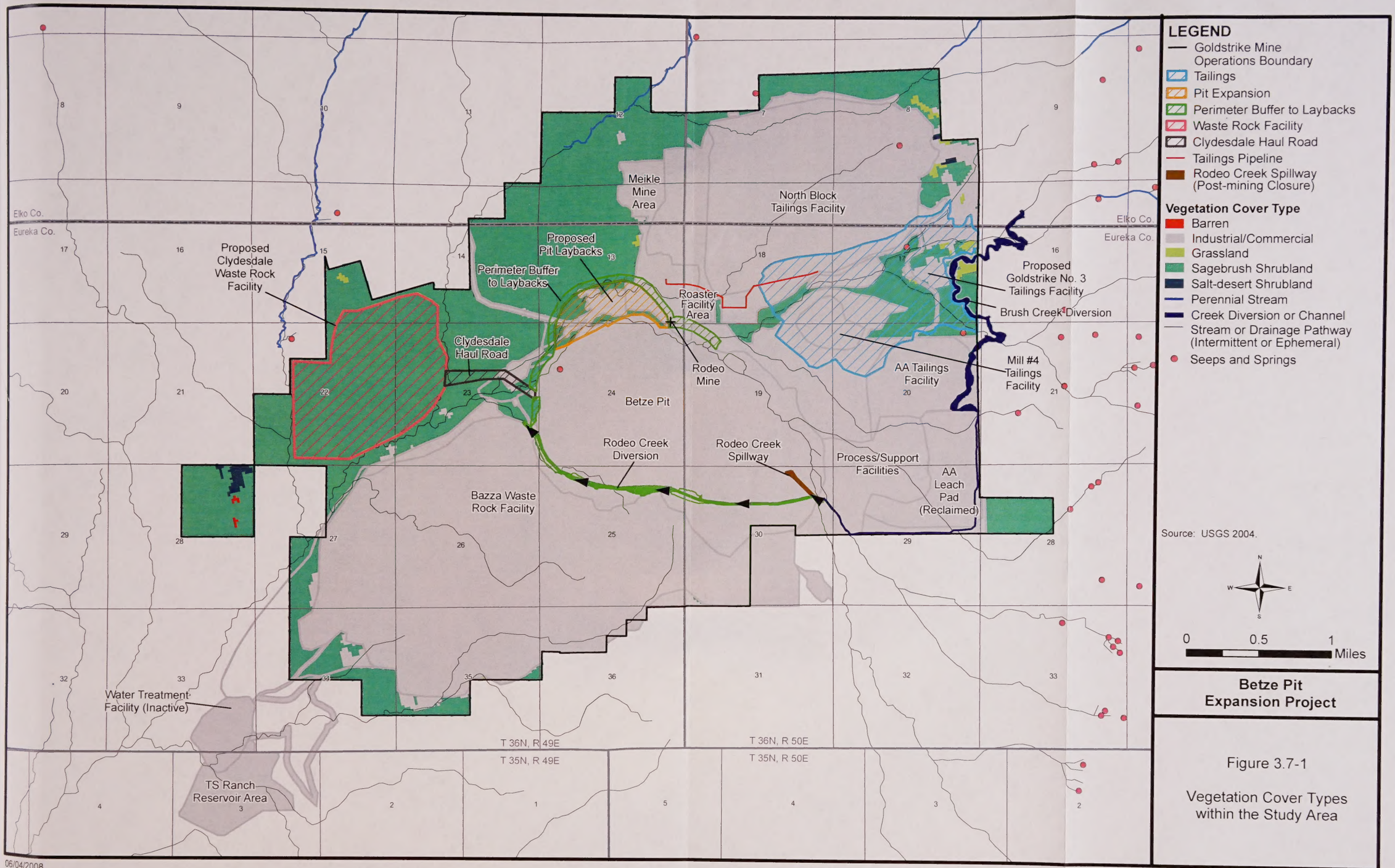
This minor vegetation cover type within the study area, the salt-desert shrubland, is characterized by open-canopied shrublands of typically lower elevational slopes, saline basins, alluvial slopes, and plains. Substrates are often saline and calcareous, medium to fine-textured, alkaline soils, but they may also include some courser-textured soils. The vegetation is characterized by an open to moderately dense shrubland dominated by shadscale saltbush (*Atriplex confertilfolia*), fourwing saltbush (*A. canescens*), cattle saltbush (*A. polycarpa*), spinescale saltbush (*A. spinfera*), greasewood, Wyoming big sagebrush, yellow rabbitbrush, rubber rabbitbrush, Mormon tea, spiny hopsage (*Grayia spinosa*), winterfat, and littleleaf horsebrush (*Tetradymia glabrata*). The understory is comprised of galleta grass, Indian ricegrass, blue grama, thickspike wheatgrass, western wheatgrass (*Pascopyron smithii*) and a small variety of forbs, including scalebud (*Anisocoma acaulis*), primrose (*Camissonia* sp., *Oenothera* sp.), Steve's dustymaiden (*Chaenactis stevoides*), and annual buckwheat (*Eriogonum* sp.) (USDA NRCS 2007b; USGS 2004).

Riparian/Wetland

Riparian/wetland habitat in the region is characterized as Great Basin foothill and lower montane riparian woodland and shrubland, North American arid west emergent marsh, and open water habitats (USDA NRCS 2007b; USGS 2004). Riparian/wetland communities are not present within the mine operations area.

Industrial/Commercial

This land use cover type is characterized by the existing mine operations within the study area and is generally sparsely vegetated with early seral stage species (USGS 2004). This land use comprises approximately 69 percent of the mine operations boundary.

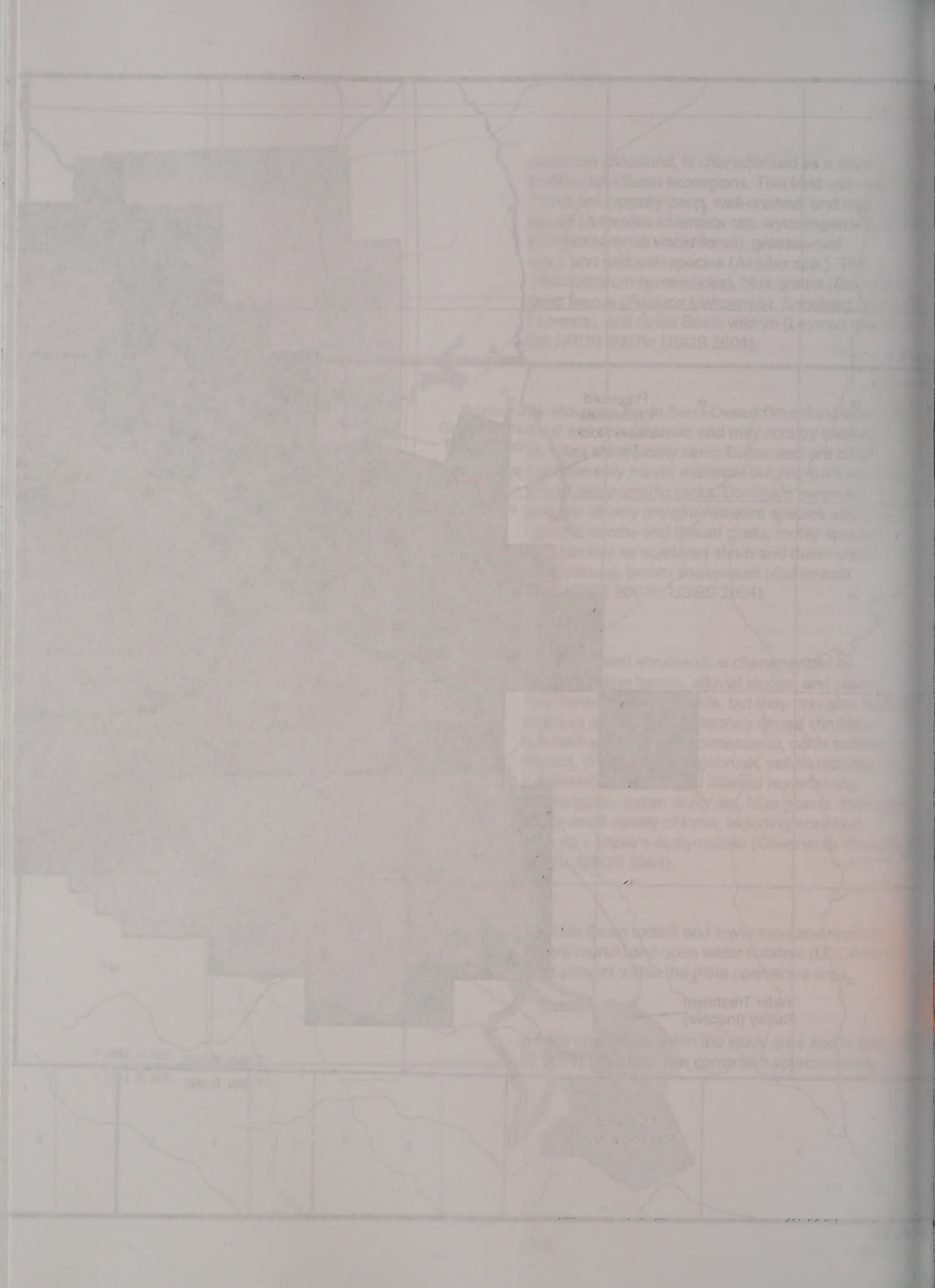


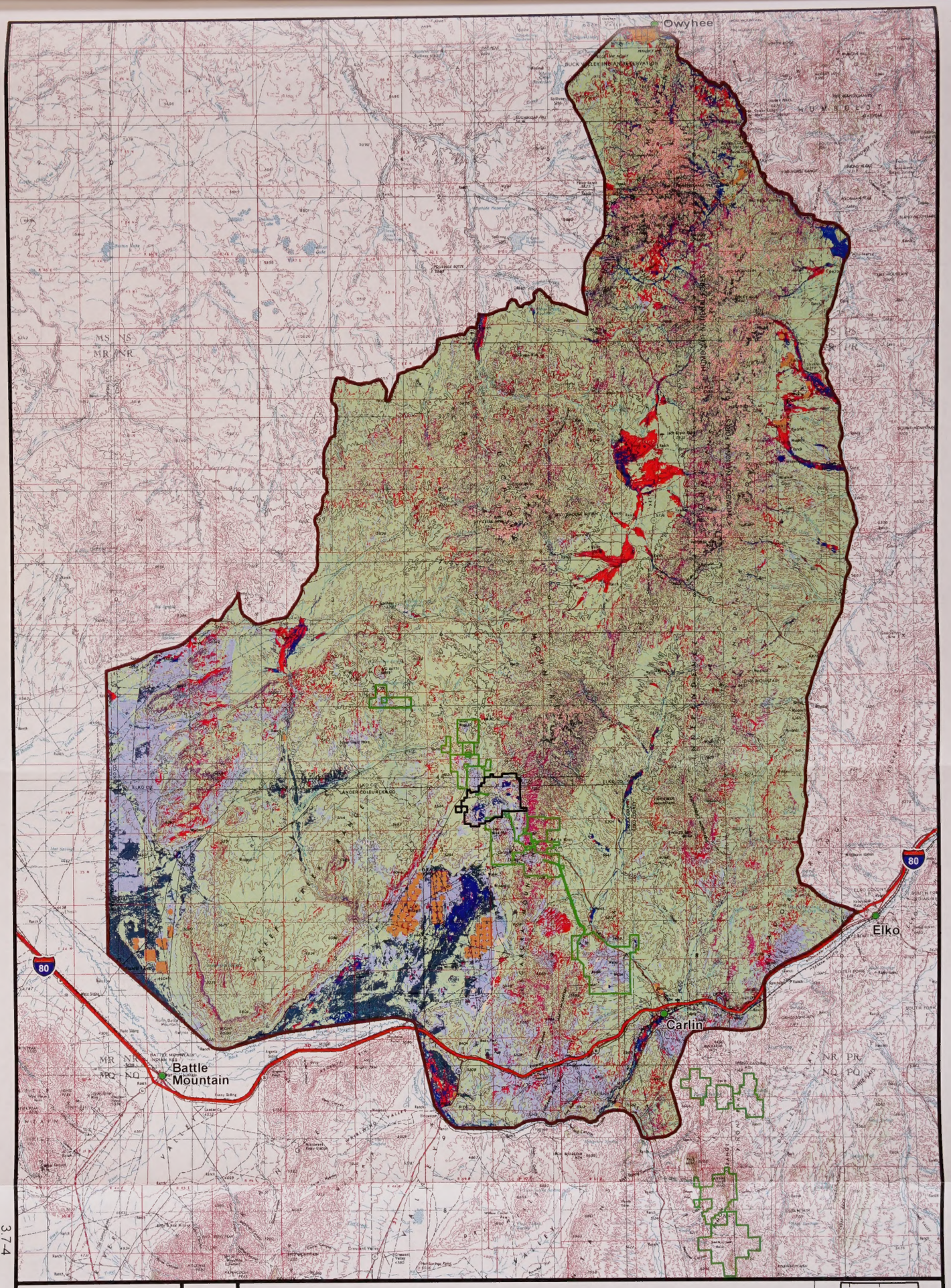
Betze Pit Expansion Project

Figure 3.7-1

Vegetation Cover Types within the Study Area

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Vegetation Cumulative Effects Study Area

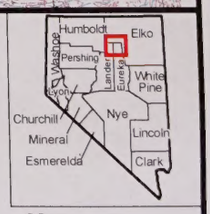
Figure 3.7-2

Betze Pit Expansion Project

LEGEND

- Vegetation Cumulative Effects Study Area
- Goldstrike Mine Operations Boundary
- Mine Plan Boundaries

- Agriculture
- Barren
- Cliff/Canyon
- Forest
- Grassland
- Industrial/Commercial
- Piñon-juniper Woodland
- Riparian/Wetland
- Sagebrush Shrubland
- Salt-desert Shrubland



N

0 5 10 Miles

Source: USGS 2004.

3.7-4

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Barren

This minor land use cover type is characterized as: 1) barren areas of bedrock, desert pavement, scarps, talus, volcanic material, glacial debris, sand dunes, strip mines, gravel pits, or other accumulations of earthen material; and 2) Inter-Mountain Basin Playa. Playa habitats are composed of barren and sparsely vegetated areas characterized by salt crusts with small saltgrass beds in depressions and sparse shrubs around the margins. These systems are intermittently flooded. The water is prevented from percolating through the soil by an impermeable soil subhorizon and is left to evaporate. Soil salinity varies greatly with soil moisture and thus affects species composition. Common species may include iodinebush (*Allenrolfea occidentalis*), greasewood, spiny hopsage, Lemmon's alkaligrass (*Puccinellia lemmonii*), Great Basin wildrye, saltgrass (*Distichlis spicata*), and saltbush. Generally, this vegetation accounts for less than 15 percent of the total herbaceous cover (USDA NRCS 2007b; USGS 2004).

3.7.1.2 Wetlands and Riparian Areas

The wetlands and riparian resources study area and CESA would be the same as presented for Upland Vegetation described in Section 3.7.1.1. Wetland and riparian habitat characterizations were compiled based on color-infrared aerial photograph interpretation, agency consultation, and watershed descriptions as previously described in the Betze Project Draft EIS and subsequent Draft and Final SEIS (BLM 1991a, 2000a, 2003a). Only drainages within the wetland and riparian resources region (i.e., Boulder Flat Watershed Subbasin) were examined in this section; detailed discussions regarding surface water within the adjacent groundwater basins and seep and springs data are presented in Section 3.3, Groundwater Resources and Geochemistry, and Section 3.4, Surface Water Resources.

Within the Boulder Flat Watershed Subbasin, Bell, Brush, and Rodeo creeks pass through the study area as tributaries to Boulder Creek to the north (**Figure 3.3-1,** Boulder Flat Watershed Subbasin). Flow occurrence within these tributaries is either ephemeral or intermittent and varies by reach. A flow diversion for Brush Creek has been completed within the study area (**Figure 3.7-1**). As presented in Section 3.4, Surface Water Resources, Rodeo Creek will be diverted in 2009 from its current location in a man-made channel north of the Betze Pit into a newly constructed channel on the south side of the pit. Downstream of the pit, Rodeo Creek will flow in its original channel. Flows from catchments upstream of BGMI's property on Rodeo Creek are attenuated by the Rodeo Creek Diversion dam. The Brush Creek Diversion project re-routes flows from Brush Creek to Rodeo Creek just downstream of the Rodeo Creek Diversion dam.

Riparian communities adjacent to these waterbodies vary with elevation and flow occurence. Along intermittent reaches, an overstory of narrowleaf willow (*Salix exigua*), Pacific willow (*S. lucida* ssp. *lasiandra*), yellow willow (*S. lutea*), and Lemmon's willow (*S. lemmonii*) and understory of silver buffaloberry (*Shepherdia argentea*), basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*), golden currant (*Ribes aureum*), Woods' rose (*Rosa woodsii*), and rubber rabbitbrush occur (USDA NRCS 2007b). Ephemeral reaches typically contain less hydrophytic vegetation species and may include sagebrush, rabbitbrush, and greasewood species, and bunchgrasses along the banks.

In compliance with the aforementioned agencies and regulations, a jurisdictional determination was received from the Sacramento District Office of the USACE for the study area. A jurisdictional determination for the proposed project was received by BGMI on November 20, 2006. At that time, the Sacramento District concluded, upon review of JBR's 2006 Boulder Creek Jurisdictional Status Review, that Bell, Brush, and Rodeo creeks and their associated ephemeral drainages in that basin are not currently regulated by the USACE under Section 404 and that the proposed project would not need a USACE permit to proceed with project implementation (USACE 2006). Based on the definitions provided above, no jurisdictional wetlands are present within the study area. Generally, no wetlands or riparian areas occur within the Goldstrike Mine operations boundary. Surface flows are intermittent to ephemeral within the mine area and most drainages, including Rodeo Creek, have been channelized to route flow around mine facilities.

3.7.1.3 Special Status Plant Species

Special status species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. Included in this category are federally listed species that are protected under the ESA, species of concern as identified by the USFWS, and species designated as state sensitive by the BLM.

No threatened, endangered, rare, or sensitive plant species were identified as potentially occurring within the study area (BLM 2007d; Nevada Natural Heritage Program [NNHP] 2007; USFWS 2007b).

Based on the special status species analysis conducted for the Betze Project SEIS (BLM 2000a), the Lewis buckwheat, a BLM sensitive species, may occur within the CESA (**Figure 3.7-2**) based on presence of suitable habitat characteristics. The Lewis buckwheat (*Eriogonum lewisii*) is a Nevada endemic species known from Elko County and northern Eureka County. This species inhabits dry, exposed, shallow, relatively barren and undisturbed, rocky residual soils on convex ridgeline knolls and crests underlain by siliceous carbonate rocks, on flat to moderately steep slopes of all aspects. The species is generally associated with little sagebrush (*Artemisia arbuscula*) and squirreltail (*Elymus elymoides*) vegetation communities. Occasionally found at lower elevations on clay hills derived from silty carbonate or calcium-rich siliceous rock, this species inhabits elevations ranging from 6,470 to 9,720 feet amsl (NNHP 2001). Based on the presence of suitable habitat within the CESA, the potential for this species to occur is considered moderate.

State law under NRS 527.060-527.120 regulates the commercial harvest, possession, and transportation of any cactus, evergreen tree, or member of the Yucca or Agave genera (Nevada Legislature 2005a). These species, their associated habitats, and their potential for occurrence within the study area were analyzed based on habitat requirements and/or known distribution. Species that may be encountered within the study area include saint cactus (*Echinocereus engelmannii* var. *chrysocentrus*), Mohave prickly pear (*Opuntia erinacea* var. *utahensis*), Plains prickly pear (*Opuntia polycantha* var. *rufispina*), sand cholla (*Opuntia pulchella*), foxtail cactus (*Coryphantha vivipara* var. *rosea*), and hedgehog thistle (*Pediocactus simpsonii* var. *simpsonii*). Based on the presence of suitable habitat, the potential for these species to occur within the study area would be considered moderate.

3.7.1.4 Noxious Weeds and Invasive Species

The noxious weeds and invasive species study area for direct and indirect impacts and the CESA would be the same as presented for vegetation. Definitions of terms and a brief listing of applicable regulations governing noxious weeds and invasive species are provided below.

A "noxious weed" is defined as any species of plant that is, or is likely to be, detrimental or destructive and difficult to control or eradicate (NRS 555.010-555.220). Noxious weeds have become a growing concern in Nevada based on their ability to increase in cover relative to surrounding vegetation and exclude native plants from an area. The spread of noxious weeds has resulted in substantial economic impacts on some sectors of the State of Nevada (state). As a result, the state has enacted laws requiring the control of noxious weed species (NRS 555.005, NAC 555.010). In addition, the federal Noxious Weed Act of 1974, as amended (7 United States Code [USC] 2801 et. seq.) requires cooperation with state, local, and other federal agencies in the application and enforcement of all laws and regulations relating to the management and control of noxious weeds. Recognizing these regulations, the BLM requires that NEPA documents consider and analyze the potential for the spread of noxious weed species and provide preventative rehabilitation measures for each management action involving surface disturbance.

The BLM considers plants "invasive" if they have been introduced into an environment where they did not evolve. As a result, invasive species usually have no natural enemies to limit their reproduction and spreading (Westbrooks 1998). Some invasive plant species can produce substantial changes to vegetation composition, structure, or ecosystem function (Cronk and Fuller 1995).

A list of the noxious weed species designated by the state and BLM Elko District Office is provided in **Table 3.7-2**. Under NRS 555.010-555.220, noxious weeds are classified into three categories: A, B, and C. Each category has specific control requirements, with the most stringent requirements for those species found in Category A.

Table 3.7-2 Designated Noxious Weed Species Potentially Occurring within the Study Area

Common Name	Scientific Name	NRS Designated Noxious Weed Species Category[1]
Russian knapweed	*Acroptilon repens*	B
Camel thorn	*Alhagi camelorum*	A
Mayweed chamomile	*Anthemis cotula*	A
Giant reed	*Arundo donax*	A
Sahara mustard	*Brassica tournefortii*	B
Whitetop or hoary cress	*Cardaria draba*	C
Musk thistle	*Carduus nutans*	B
Purple starthistle	*Centaurea calcitrapa*	A
Diffuse knapweed	*Centaurea diffusa*	B
Iberian star thistle	*Centaurea iberica*	A
Spotted knapweed	*Centaurea maculata*	A
Malta starthistle	*Centaurea melitensis*	A
Yellow starthistle	*Centaurea solstitialis*	A
Squarrose knapweed	*Centaurea virgata* var. *squarrosa*	A
Rush skeletonweed	*Chondrilla juncea*	A
Water hemlock	*Cicuta maculata*	C
Canada thistle	*Cirsium arvense*	C
Poison hemlock	*Conium maculatum*	C
Common crupina	*Crupina vulgaris*	A
Houndstongue	*Cynoglossum officinale*	A
Leafy spurge	*Euphorbia esula*	A
Goat's rue	*Galega officinalis*	A
Hydrilla	*Hydrilla verticillata*	A
Black henbane	*Hyoscyamus niger*	C
Klamath weed	*Hypericum perforatum*	A
Dyer's woad	*Isatis tinctoria*	A
Tall whitetop or perennial	*Lepidium latifolium*	C
Dalmatian toadflax	*Linaria dalmatica*	A
Yellow toadflax	*Linaria vulgaris*	A

Table 3.7-2 Designated Noxious Weed Species Potentially Occurring within the Study Area

Common Name	Scientific Name	NRS Designated Noxious Weed Species Category[1]
Purple loosestrife	*Lythrum salicaria*	A
Eurasian water-milfoil	*Myriophyllum spicatum*	A
Scotch thistle	*Onopordum acanthium*	B
African rue	*Peganum harmala*	A
Green fountaingrass	*Pennisetum setaceum*	C
Sulfur cinquefoil	*Potentilla recta*	A
Austrian fieldcress	*Rorippa austriaca*	A
Mediterranean sage	*Salvia aethiopis*	A
Giant salvinia	*Salvinia molesta*	A
Carolina horse-nettle	*Solanum carolinense*	B
White horse-nettle	*Solanum elaeagnifolium*	B
Sow thistle	*Sonchus arvensis*	A
Johnson grass	*Sorghum halepense*	C
Austrian peaweed	*Sphaerophysa salsula* (= *Swainsona salsula*)	A
Medusahead	*Taeniatherum caput-medusae*	B
Saltcedar or tamarisk	*Tamarix ramosissima*	C
Puncture vine	*Tribulus terrestris*	C
Syrian bean caper	*Zygophyllum fabago*	A

[1] No additional noxious weeds or invasive species were identified by Elko County. Elko County manages for the species listed by the State of Nevada in their jurisdiction.

Source: Nevada Department of Agriculture, Plant Industry Division 2006; Eklund-Brown 2007.

Category A includes noxious weeds, which are:

- Not found or limited in distribution throughout the state;
- Actively excluded from the state and actively eradicated wherever found; and
- Controlled by the state for all infestations.

Category B includes noxious weed species, which are:

- Established in scattered populations in some counties of the state;
- Actively excluded where possible; and
- Controlled by the state in areas where populations are not well established or previously unknown to occur.

Category C includes noxious weeds, which are:

- Currently established and generally widespread in many counties of the state; and
- Controlled and abated at the discretion of the state quarantine officer (Nevada Department of Agriculture 2006).

Baseline vegetation studies, which included field assessments and subsequent documentation of invasive non-native plant species occurrences, were conducted within BGMI's property boundary in 2006. Based on 2006 field observations, Scotch thistle and whitetop populations continue to colonize previously disturbed areas within the BGMI property boundary (specific to the BGMI operations area) (Cedar Creek Associates, Inc. 2007a). **Figure 2-10** shows the locations of noxious weed areas observed and treated during 2002 to 2006 within the Goldstrike Mine operations boundary.

3.7.2 Environmental Consequences

The primary issues associated with vegetation resources include direct and/or indirect impacts to upland vegetation, riparian/wetland habitats, special status plant species, and impacts associated with the introduction and/or spread of noxious weeds and invasive species.

3.7.2.1 No Action Alternative

Under the No Action Alternative, groundwater pumping will occur for an additional 4 years from 2012 through 2015 under State of Nevada authorizations and permits. **Figure 3.3-26** and **Figure 3.3-48** illustrate the maximum extent of the10-foot groundwater drawdown under the No Action Alternative and the mitigation provided for in the 2000/2003 Betze SEIS (BLM 2000a, 2003a) as described in Sections 3.3.3.1 and 3.3.4.2.

As stated in Section 3.4, Surface Water Resources, the Rodeo Creek Diversion will route flows from its existing channel north of the pit to a new channel south of the Betze Pit and back into the original channel downstream of the pit. As a mine closure option, Rodeo Creek flows may be diverted again at the end of mining into the pit, pending authorization by the State of Nevada.

Upland Vegetation

Under the No Action Alternative, the proposed project expansion would not be developed and existing facilities would continue to operate as currently authorized by the BLM and the State of Nevada. Construction of the Rodeo Creek Diversion to the south of the Betze Pit would result in disturbance to existing vegetation. However, most of the proposed diversion route occurs on previously disturbed land. Ongoing reclamation would minimize existing impacts to vegetation in mine-related disturbance areas (with the exception of the Betze Pit laybacks, which will not be reclaimed).

Under the No Action Alternative, no impacts to upland vegetation are anticipated as a result of dewatering activities because groundwater drawdown does not affect upland vegetation.

Wetlands and Riparian Areas

There would be no impacts to wetlands and riparian areas in the study area as a result of the No Action Alternative. No jurisdictional wetlands are present in the study area. There are no riparian communities in downstream reaches of Rodeo Creek below the Rodeo Creek Diversion, so there would be no impacts.

The mitigation specified in Appendix A of the Betze Project SEIS (BLM 2003a) addressed all direct, indirect, and cumulative impacts within the maximum cumulative 10-foot drawdown contour (**Figure 3.3-48**). Therefore, the 2007 groundwater modeling has not resulted in any new impacts to wetlands and riparian areas beyond those that were discussed and covered by mitigation in the Betze SEIS (BLM 2003a).

As discussed in the previous Betze Project SEIS (BLM 2000b, 2003a), wetland vegetation has developed within the CESA (**Figure 3.7-2**) subsequent to the appearance of Green, Knob and Sand Dune springs from infiltration activities at the TS Ranch Reservoir in an area of historically saline (sodic) soils. This area is located on private land held by Newmont, an adjacent land owner. At the end of infiltration activities, the water levels will gradually subside and the wetland vegetation will decline, being replaced over time by salt-tolerant species (BLM 2000b, 2003a), returning the area to its preexisting conditions. During the transition from wetland to salt-tolerant upland species, there may be a need to assist in the establishment of salt-tolerant species by seeding and the control of noxious/invasive species. This would aid in control of undesirable plant species and reduce potential particulate fugitive dust emissions. Any such measures employed would be subject to a private contractual agreement between BGMI and Newmont.

In addition, 10,000 acres of agricultural lands owned by Newmont are currently irrigated with mine dewatering water. When excess mine water is no longer available for irrigation Newmont may or may not continue irrigation depending on economics and water availability. That is a discretionary choice of a private landowner over which the BLM has no authority. If the land is taken out of production when dewatering ceases, adverse impact could result including accelerated eolian or surface water erosion, fugitive dust emissions, fire, and noxious/invasive species infestations. Mitigation to reduce such impacts would be the same as described in the paragraph above and is subject to the same limitations. At present, there are no commitments to conduct mitigation. BGMI has declined to pursue an agreement at this time.

Special Status Plant Species

As discussed in Section 3.7.1.3, Special Status Plant Species, the Lewis buckwheat may occur within suitable habitat within the 10-foot drawdown contour. Under the No Action Alternative, no impacts to the Lewis buckwheat are anticipated since this species is an upland plant species and all impacts under this alternative would be associated with groundwater drawdown and its associated impacts to riparian and wetland species and their habitats.

Noxious Weeds and Invasive Species

Existing BGMI weed control measures would continue to be implemented to prevent the establishment of new populations and to control existing populations in mine-related disturbance areas.

It is anticipated that a continued decrease or cessation of flow in seeps, springs, and intermittent waterbodies within the mine-related 10-foot groundwater drawdown contour may increase the likelihood of the potential establishment of noxious weeds and invasive species known to invade riparian/wetland habitats (e.g., saltcedar and Russian olive). Consequently, a decrease or cessation of flow may provide suitable habitat for noxious weeds and invasive species which prefer drier conditions.

3.7.2.2 Proposed Action

Upland Vegetation

Under the Proposed Action, mine development and operation would remove approximately 867 acres of predominantly shrub-dominated vegetation communities (**Table 3.7-3**). This loss would represent a long-term impact as it would take up to 25 years following reclamation for mature shrub species to re-establish. A permanent loss of 129 acres of vegetation cover types would occur under the Proposed Action.

Reclamation would be completed on approximately 1,262 (85 percent) of the total proposed disturbance area. As discussed in Section 2.3.7.3, Reclamation, the Betze Pit is the only project component that would not be reclaimed. To minimize mine-related impacts to vegetation, reclamation would be conducted as soon as practical, with concurrent reclamation implemented to the maximum extent possible as discussed in Section 2.2.1.13, Applicant-committed Environmental Protection Measures. Reclamation activities would

Table 3.7-3 Summary of Vegetation Cover Types Affected by the Proposed Action

Facility	Vegetation Cover Type (acres)						Summary Data (acres)				
	Sagebrush Shrubland	Grassland	Salt-desert Shrubland	Riparian/ Wetland[1]	Industrial/ Commercial	Barren	Total Disturbed	Existing Authorized Disturbance	Proposed Action Net Disturbance	Bazza Waste Rock Facility Alternative Disturbance	Post-mining Reclaimed
Clydesdale Waste Rock Facility	535	0.0	0.0	0.0	0.0	0.0	535.0	0.0	535.0	0.0	535.0
Pit Layback and Buffer Perimeter	100.5	0.0	0.0	0.0	114.5	0.0	215.0	-86.3.0	128.7	128.7	0.0
Goldstrike No. 3 Tailings Facility	202.4	75.8	0.0	0.0	411.8	0.0	690.0	-211.0	479.0	479.0	690.0
Haul Road	29.5	0.0	0.0	0.0	7.2	0.1	36.8	0.0	36.8	0.0	36.8
Total[2]	**867**	**76**	**0**	**0**	**534**	**0**	**1,477**	**-297**	**1,180**	**608**	**1,262**

[1]Vegetation cover types were compiled based on USGS SWReGAP data (USGS 2004). As such, spatial limitations are attributed to this data set since it was collected on a regional landscape level. Note that this data (i.e., vegetation cover types and their associated acreages) are approximate.

[2]Totals have been rounded to the nearest acre.

include, but are not limited to, the grading of final slopes, ripping of compacted soil, potential reapplication of growth media, and broadcasting of seed. Seed mixes, as described in Section 2.2.3.3, Seed Mixes, would be Reclamation monitoring conducted at the AA Leach Pad and the Bazza Waste Rock Facility has confirmed completion of successful reclamation as compared to adjacent undisturbed vegetation communities (i.e., vegetation composition, quality, and quantity) (Cedar Creek Associates 2007a).

Under the Proposed Action, reclamation of the Bazza Waste Rock Facility would be accelerated. Reclamation of the Bazza Facility would be substantially completed by the end of 2011, 7 years earlier than planned for the Bazza facility under the No Action Alternative.

Wetland and Riparian Areas

Under the Proposed Action, no surface disturbance-related impacts to wetland or riparian communities would occur because these communities are not present within the mine boundary. The potential impacts to Boulder Valley wetlands and irrigated lands when mine dewatering ends would be the same as discussed in Section 3.7.2.1 in the Wetlands and Riparian Areas subsection of the No Action Alternative. Mitigation to reduce such impacts would be the same and would be subject to the same limitations.

Special Status Plant Species

No threatened, endangered, rare, or sensitive plant species were identified as potentially occurring within the vegetation resources study area (BLM 2007d; NNHP 2007; USFWS 2007b), and as such, no impacts are anticipated. Based on habitat requirements and known distribution, cactus and/or members of the Yucca or Agave genera constitute a moderate potential for occurrence within the Proposed Action disturbance areas. However, NRS states that only the commercial harvest, possession, or transportation of such species would be regulated. Under the Proposed Action, these actions are not anticipated. However, if these actions would occur, landowner permission must be obtained prior to activity commencement.

Noxious Weeds and Invasive Species

Noxious weeds and invasive species readily invade areas that have been subject to surface disturbance, which typically lack, or have minimal vegetative cover. Under the Proposed Action, mine development and operation would remove or disturb approximately 1,180 acres of vegetation, of which 129 acres would not be reclaimed.

Implementation of BGMI's Reclamation Plan (Sections 2.2.3 and 2.3.7.3) would reduce the potential for noxious weeds and invasive species establishment in the study area. However, minor populations of non-native annual species (e.g., halogeton, cheatgrass) may become established in localized areas for short periods of time.

To stabilize the growth media, reduce soil erosion, and minimize the potential for the establishment of noxious weeds and invasive species, growth media stockpiles would be reclaimed with an interim seed mix. In addition, the design and construction of the proposed mine facilities would facilitate concurrent reclamation to the maximum extent possible. Successful reclamation of mine-related disturbance areas (including pit backfill areas) would result in the establishment of a permanent vegetative cover, which would minimize the potential establishment of noxious weeds and invasive species in the long term. Although the proposed Betze Pit would not be reclaimed, noxious weeds and invasive species would not likely become established in these areas due to the absence of soil and the formation of the pit lake in the long term. As described in Section 2.2.1.13, Applicant-committed Environmental Protection Measures, certified weed-free seed mixes and mulches would be used for reclamation. If noxious weeds and invasive species become established in project-related disturbance areas, a weed removal or spraying program would be implemented. As described in Section 2.2.3.4, Noxious Weed Management, weed control practices would be implemented during vegetation establishment to limit the growth and spread of invasive, nonnative species and facilitate successful revegetation with the proposed seed mixes. Weed control practices would be implemented in coordination with the BLM Elko District Office to limit the spread and introduction of noxious weeds in the study area.

3.7.2.3 Bazza Waste Rock Facility Alternative

The Bazza Waste Rock Facility Alternative would result in the continued use of the Bazza Waste Rock Facility without construction of the proposed Clydesdale Waste Rock Facility. Under this alternative, the Bazza Waste Rock Facility would not be completely reclaimed until 2018, compared with 2011 for the Proposed Action. BGMI would implement existing management plans and would adhere to all applicable federal, state, and local requirements.

Upland Vegetation

Under the Bazza Waste Rock Facility Alternative, direct and/or indirect surface disturbance-related impacts to vegetation resources would be approximately 565 acres less than under the Proposed Action since the Clydesdale facility and haul road would not be constructed (**Table 3.7-3**). Anticipated impacts and mitigation measures would be the same as described for the Proposed Action.

The Bazza Waste Rock Facility Alternative would result in the loss of 0.5 million tons of Carlin Material (an excellent growth media) excavated from the proposed northwest laybacks of the Betze Pit. The material would be unavailable for future reclamation of the Bazza Waste Rock Facility because Carlin Material does not stockpile well due to its physical properties and slope stability concerns (see Section 2.4, Bazza Waste Rock Facility Alternative). The loss of Carlin Material would result in the use of lower quality growth media (i.e., subsoil or waste rock), which would be less conducive to vigorous and diverse plant growth. Lower quality vegetation production would reduce the available forage (including production rates and values) for wildlife species and the reclamation areas may be more susceptible to erosion (Cedar Creek Associates 2007a).

Wetlands and Riparian Areas

Under the Bazza Waste Rock Facility Alternative, no direct and/or indirect surface disturbance and water management-related activities affecting wetland and riparian resources would occur, and as such, no impacts are anticipated.

Special Status Plant Species

As stated in Section 3.7.1.3, Special Status Plant Species, no threatened, endangered, rare, or sensitive plant species were identified as potentially occurring within the vegetation resources study area (BLM 2007d; NNHP 2007; USFWS 2007b), and as such, no impacts are anticipated.

Noxious Weeds and Invasive Species

Under the Bazza Waste Rock Facility Alternative, direct and/or indirect surface disturbance-related impacts to noxious weeds and invasive species would be approximately 565 acres less than under the Proposed Action (**Table 3.7-3**). Anticipated impacts and mitigation measures would be the same as described for the Proposed Action. As stated above, the loss of Carlin Material for reclamation could adversely impact revegetation success. As a result, the inability for native desirable species to recolonize any given area would have a direct impact on the ability for noxious weed and invasive species to become introduced and/or spread at this site.

3.7.3 Cumulative Impacts

The cumulative effects study area for vegetation resources encompasses 2,389,957 acres and is shown in **Figure 3.7-2**. Past and present actions and RFFAs are described in Section 3.1. Past, present, and RFFAs, including wildland fires, within the CESA have resulted in approximately 996,039 acres of surface disturbance to vegetation resources from 1999 to mid-2007 (Section 3.1).

3.7.3.1 No Action Alternative

Upland Vegetation

No direct or indirect impacts to upland vegetation in the study area are anticipated under the No Action Alternative. Consequently, no cumulative effects are anticipated.

Wetlands and Riparian Areas

Surface waterbodies, seeps, springs, within the 10-foot cumulative drawdown area effects are discussed in Sections 3.3 and 3.4, Groundwater Resources and Geochemistry and Surface Water Resources, respectively. Any riparian areas fed by these surface waterbodies, seeps, or springs within the CESA may be impacted as a result of combined groundwater pumping. However, these impacts are within the area that was disclosed and mitigated for in the 2000/2003 Betze SEIS (BLM 2000a, 2003a) as shown in **Figure 3.3-48** and described in Sections 3.3.3.1 and 3.3.4.2.

Species Status Plant Species

No direct or indirect impacts to special status plant species in the study area are anticipated under the No Action Alternative. Consequently, no cumulative effects are anticipated.

Noxious Weeds and Invasive Species

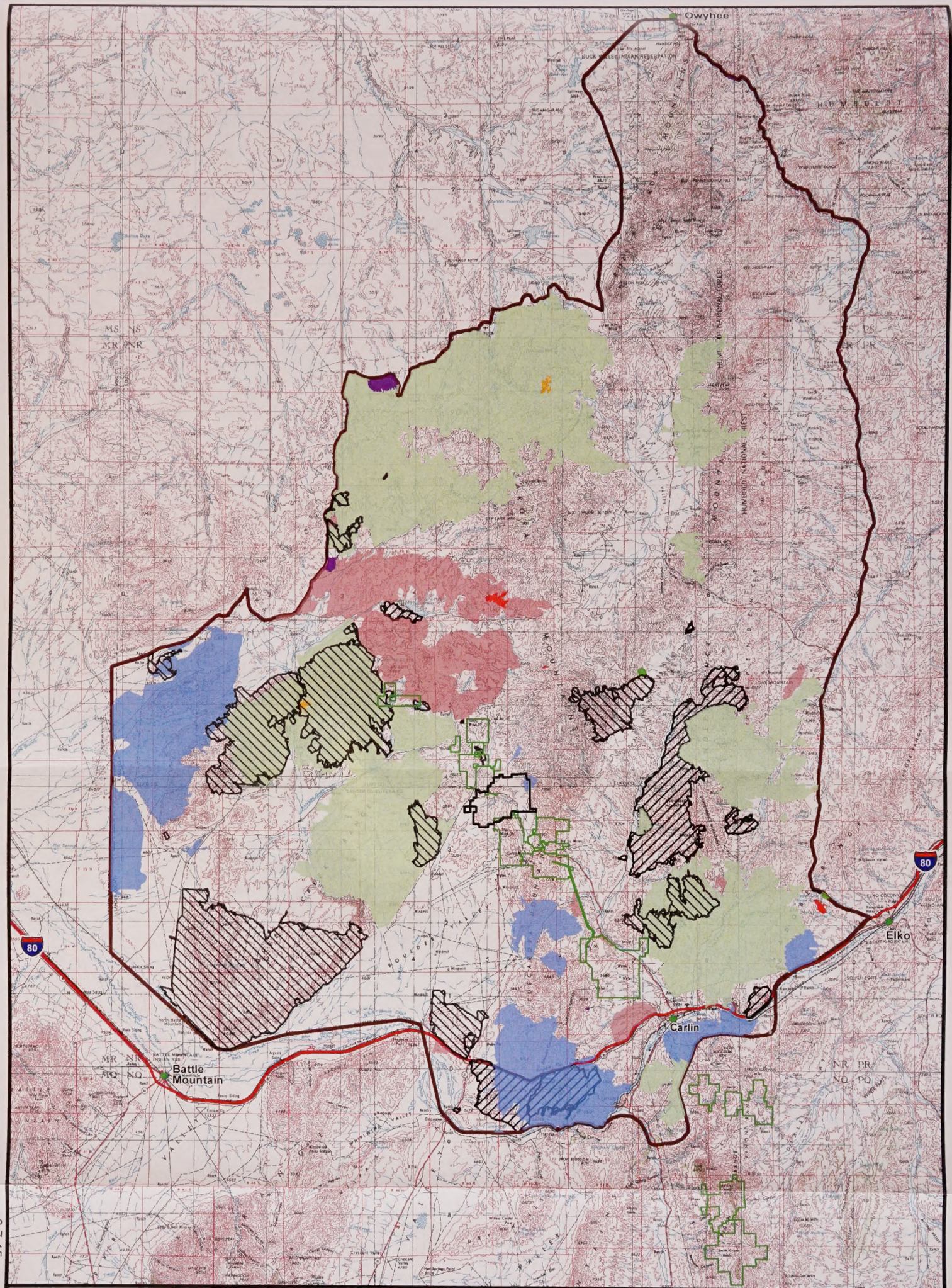
No direct impacts to noxious weeds and invasive species in the study area are anticipated under the No Action Alternative. Consequently, no cumulative effects are anticipated.

3.7.3.2 Proposed Action

Upland Vegetation

The Proposed Action incrementally would increase surface disturbance-related impacts to upland vegetation resources within the CESA by approximately 1,180 additional acres, resulting in an overall cumulative effect to 996,039 acres of upland vegetation. It is assumed that portions of past disturbances have been reclaimed. Pending completion of successful reclamation, the incremental additional impacts to upland vegetation as a result of the Proposed Action would be temporary in nature for the majority of the surface disturbance-related areas, with the exception of the Betze Pit, which would not be reclaimed. The loss of mature shrubs would be minimal relative to the total acreage of woody species communities that occur within the CESA. The removal of woody species from these areas would result in a long-term change in vegetation structure since it would take up to 25 years for shrub species of similar stature to become re-established in these areas.

Surface disturbance associated with wildland fires accounts for approximately 920,471 acres (92 percent) of the total surface disturbance area within the CESA (**Figure 3.7-3**). Direct and indirect impacts to vegetation resources include the complete loss or partial removal of upland vegetation species, potential removal of belowground biomass, soil hydrophobicity, and the potential spread and/or introduction of noxious weeds and invasive species. Impacts to vegetation resources may vary depending on fire intensity, duration, and frequency. It is assumed that partial recolonization has occurred within wildland fire-related surface disturbance areas. Recovery timeframes for herbaceous and woody species would be relatively similar to those described above for other surface disturbance-related activities.



3.7-15

Historical Fires - 1999 through July 2007 Cumulative Effects Study Area

Figure 3.7-3

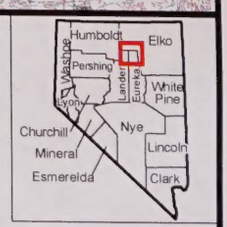
Betze Pit Expansion Project

LEGEND

- Historical Fire Cumulative Effects Study Area
- Goldstrike Mine Operations Boundary
- Mine Plan Boundaries

Fire Years

- 1999
- 2000
- 2001
- 2002
- 2003
- 2004
- 2005
- 2006
- 2007



N

0 5 10 Miles

Source: BLM 2007b,c.

06/05/2008

Wetlands and Riparian Areas

Cumulative impacts to wetland and riparian areas would not occur as a result of the Proposed Action.

Special Status Plant Species

No direct and/or indirect impacts occur for special status plant species, and as such, no cumulative impacts are anticipated.

Noxious Weeds and Invasive Species

It is assumed that the majority of the surface disturbance-related impacts within the CESA would be reclaimed, minimizing the introduction and/or spread of noxious weeds and invasive species. Implementation of BGMI's Reclamation Plan would minimize the introduction and/or spread of noxious weeds and invasive species within the Proposed Action disturbance areas, thereby minimizing the project's contribution to cumulative effects. Disturbance areas within the CESA not reclaimed would be prone to the establishment of noxious weeds and invasive species. However, due to the absence of soils and the formation of pit lakes, the potential for establishment would be less likely.

3.7.3.3 Bazza Waste Rock Facility Alternative

Upland Vegetation

The Bazza Waste Rock Facility Alternative incrementally would increase surface disturbance-related impacts to upland vegetation resources within the CESA by approximately 608 additional acres, resulting in an overall cumulative effect to 995,467 acres of upland vegetation (approximately 565 fewer acres than under the Proposed Action). Anticipated cumulative impacts (including impacts resulting from wildfire) and recovery timeframes would be similar to those described under the Proposed Action.

Wetlands and Riparian Areas

No direct or indirect impacts to wetlands and riparian areas would occur under the Bazza Waste Rock Facility Alternative. Consequently, no cumulative effects are anticipated.

Species Status Plant Species

No direct or indirect impacts to special status plant species are anticipated under the Bazza Waste Rock Facility Alternative. Consequently, no cumulative effects are anticipated.

Noxious Weeds and Invasive Species

Cumulative impacts to noxious weeds and invasive species are similar to those described under the Proposed Action.

3.7.4 Mitigation Measures and Monitoring

Following construction, BGMI would revegetate disturbed areas in accordance with their Reclamation Plan. BGMI would monitor revegetation success using the presence/absence of noxious weeds and invasive species as an indicator, among others, of reclamation success. Weed infestations would be monitored as part of BGMI operations and maintenance surveys per the Reclamation Plan and BLM and NDEP regulations.

No new mitigation measures or monitoring programs beyond BGMI's current programs are proposed for vegetation resources. The reclamation activities, included as part of the Proposed Action, in conjunction with BMGI's Reclamation Plan, would substantially reduce surface disturbance-related impacts to vegetation resources.

Wetland and riparian impacts from groundwater drawdown associated with the No Action Alternative will be mitigated under existing mitigation from the 1991 Betze Project EIS and 2003 Betze Project SEIS. The 1991

EIS predicted 330 acres of wetland and riparian habitat would potentially be affected. The 2003 SEIS updated the dewatering analysis and predicted that fewer acres (150 acres) of wetlands and riparian habitat would be affected. Therefore, the current Wetland Mitigation Fund and Long-Term Monitoring and Mitigation Fund (Section 2.2.1.13) would mitigate for any additional impacts to wetlands and riparian areas.

3.7.5 Residual Impacts

Residual impacts to vegetation under the Proposed Action would include the permanent loss of vegetation from approximately 129 acres associated with the expansion of the Betze Pit, which would not be reclaimed. The loss of shrub-dominated communities from reclaimed facility areas would represent a long-term change in vegetation composition (i.e., shrub-dominated communities to grass/forb-dominated communities) under the Proposed Action and Bazza Waste Rock Facility alternatives.

3.8 Wildlife Resources

The study area for direct and indirect impacts for wildlife resources includes the proposed project boundary and riparian, perennial stream, spring/pond, and wetland habitats within the modeled mine-related 10-foot groundwater drawdown area. The CESAs for wildlife resources generally extend from the northern end of the Independence Range in the north to the Humboldt River and northern end of the Piñon Range to the south, and includes surface disturbance and water management activities associated with past and present actions and RFFAs, and wetlands and riparian habitat within the modeled groundwater drawdown area. The CESAs were determined by BLM and NDOW and include contiguous areas that provide very important seasonal habitat for wildlife species such as mule deer and pronghorn.

3.8.1 Affected Environment

As discussed in Section 3.7, Vegetation Resources, three vegetation cover types and two land use cover types are located within the study area. The vegetation cover types include salt-desert shrubland, sagebrush shrubland, and grassland habitats. The land use cover types are composed of developed lands (i.e., industrial/commercial) and barren lands. Sagebrush shrubland is the most common vegetation community within the study area. A variety of terrestrial wildlife species are associated with all of these upland communities, with greater species diversity occurring in areas exhibiting greater vegetative structure and soil moisture.

Available water for wildlife consumption is limited in the project region. Water sources in the vicinity of the project, particularly those that maintain open water and a multi-story canopy, support a greater diversity and population density of wildlife species than any other habitat types occurring in the region. Currently, the only riparian/wetland habitat occurring within the region is along upper Bell and Boulder creeks, which originate in the Tuscarora Mountains north of the study area.

Information regarding wildlife species and habitat within the study area and CESAs was obtained from a review of existing published sources, BLM, NDOW, and USFWS file information, as well as NNHP database information.

Wildlife species and habitats found within the study area are typical of the Great Basin region. The study area occurs primarily within sagebrush communities in Boulder Valley. Within the study area, wildlife habitat primarily is composed of salt-desert shrubland and sagebrush shrubland habitats.

3.8.1.1 Big Game Species

The pronghorn population has been stable to increasing in game management unit 06 (NDOW 2007b). Pronghorn use in the project vicinity has increased in recent years due to the development of agriculture in Boulder Valley, restoration of fires, and favorable weather patterns (NDOW 2008b). In order to maintain pronghorn herd health and reduce the base population, NDOW has captured and removed 166 pronghorn in 2003 and 116 pronghorn in 2008 within hunt units 067 and 068 (both within game management unit 06), which includes Boulder Valley (Gray 2008). Gray (2008) estimated that there were 550 pronghorn in these hunt units as of Spring 2008. Approximately 70 percent of the pronghorn in hunt units 067 and 068 winter in Boulder Valley (Gray 2008). Use of the study area by pronghorn is highly dependent on water and forage availability. The study area contains both summer range and very important winter range (**Figure 3.8-1**).

Population numbers for mule deer in game management unit 06 for Elko and Eureka counties have been declining for the last few years due to the reduction in winter range quality (NDOW 2007b). Large-scale fires have caused a severe reduction in available forage and an increase of noxious weeds. Fire has affected the area's mule deer herd by severely limiting forage on transitional and winter range (NDOW 2007b). The study area consists of low-density mule deer habitat, consisting primarily of sagebrush shrublands habitat and mule deer intermediate (transitional) habitat, which serves as habitat during spring and fall migration. In addition, NDOW has designated a very important migration corridor located along the western portion of the study area (**Figure 3.8-2**). Details on the big game migration corridor are presented below.

A big game migration corridor occurs in the western portion of the study area along Rodeo and Bell creeks (**Figure 3.8-2**). This area would be disturbed with the development of a new waste rock facility. Seasonal big game movement corridors between summer and winter ranges in the study vicinity have been restricted due to mining operations in the project region (NDOW 2007b). By definition, a wildlife movement corridor is a linear habitat with a primary function of connecting at least two significant habitat areas (Harris and Gallagher 1989). Throughout the western U.S., big game relies on seasonal ranges to satisfy their annual nutritional and energetic requirements (Sawyer et al. 2005). Because seasonal ranges often occur great distances apart and across a mix of vegetation types and land ownership, maintaining migration corridors is often difficult and is considered a top priority by state game agencies (Sawyer et al. 2005). The proposed Betze Pit Expansion Project and other mining operations within the Carlin Trend are located in the vicinity of migration corridors that connect important summer and winter range for big game (mule deer, pronghorn, and elk).

Historically, a large herd of mule deer migrated south from their summer range in the Tuscarora Mountains to their winter range in the lower elevations of Boulder Valley (Lamp 2007b). Little Boulder Valley, the location of the Barrick Goldstrike Mine and Newmont's Genesis/Blue Star, Lantern, Mill #1, Boostrap/Capstone, Tara, and Rossi's barite operations, and Dee's Boulder Creek and Ren mines, was the original location of the historic mule deer migration corridor for movement to and from the winter range in the Dunphy Hills. Historically, up to 4,000 deer would migrate through this area twice annually. With the development of the Carlin Trend mines in Little Boulder Valley, the deer moved their migration pattern to the east side of the South Tuscarora Range. With the development now on the east side of the range, little opportunity for north/south movement remains (NDOW 2008b). The western edge of the proposed Betze Pit Expansion Project is an area that remains highly susceptible to fragmentation. This area is considered by NDOW to be a very important migration corridor for big game (Lamp 2007b). The migration corridor that extends along Bell and Rodeo creeks is used primarily by mule deer, but it also may provide an important movement corridor for pronghorn, and to a lesser extent, elk (Lamp 2007b).

The mountain lion also is classified as a big game species. Mountain lions are fairly common in north-central Nevada and occupy the higher elevations surrounding the study area (NDOW 2007b). They often travel between mountain ranges and valleys depending on prey availability.

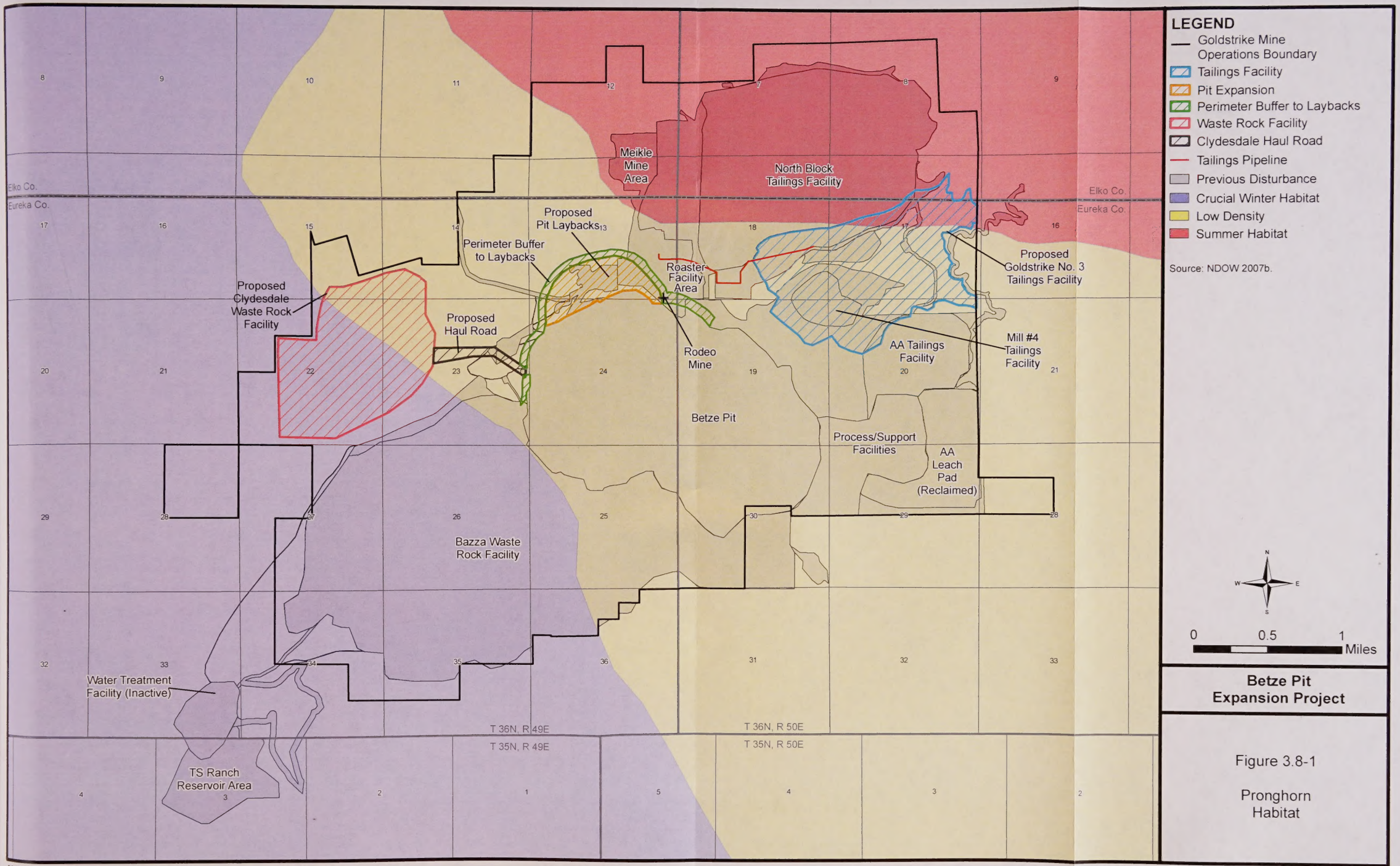
3.8.1.2 Small Game Species

Upland game birds may occupy portions of the study area, although habitat is somewhat limited. Species that may occur in the study area are greater sage-grouse, chukar, Hungarian partridge, and mourning dove. Chukar are found in the hills surrounding Little Boulder Basin especially on rocky ridges and hillsides (BLM 1991b; Lamp 2007b). Hungarian partridge are found in riparian areas and terraces along Rodeo and Bell creeks (BLM 1991b; Lamp 2007b). Mourning doves are found in a wide range of habitats in close proximity to water and are most likely to occur within the study area during spring, summer, and early fall. The greater sage-grouse is a BLM sensitive species and is discussed in detail in Section 3.8.1.5, Special Status Species.

The pygmy rabbit is a game species that has been documented in the project vicinity (Lamp 2007b). Although the pygmy rabbit is considered a game species in Nevada, it also is a BLM sensitive species and is discussed in Section 3.8.1.5, Special Status Species. Other small game mammal species that could occur within the study area are mountain cottontail and black-tailed jackrabbit.

Furbearers that may occur within the study area include the badger, gray fox, kit fox, bobcat, and raccoon (Hall 1995). Additional mammals that may be found within the study area include coyote, long-tailed weasel, short-tailed weasel, spotted skunk, and striped skunk.

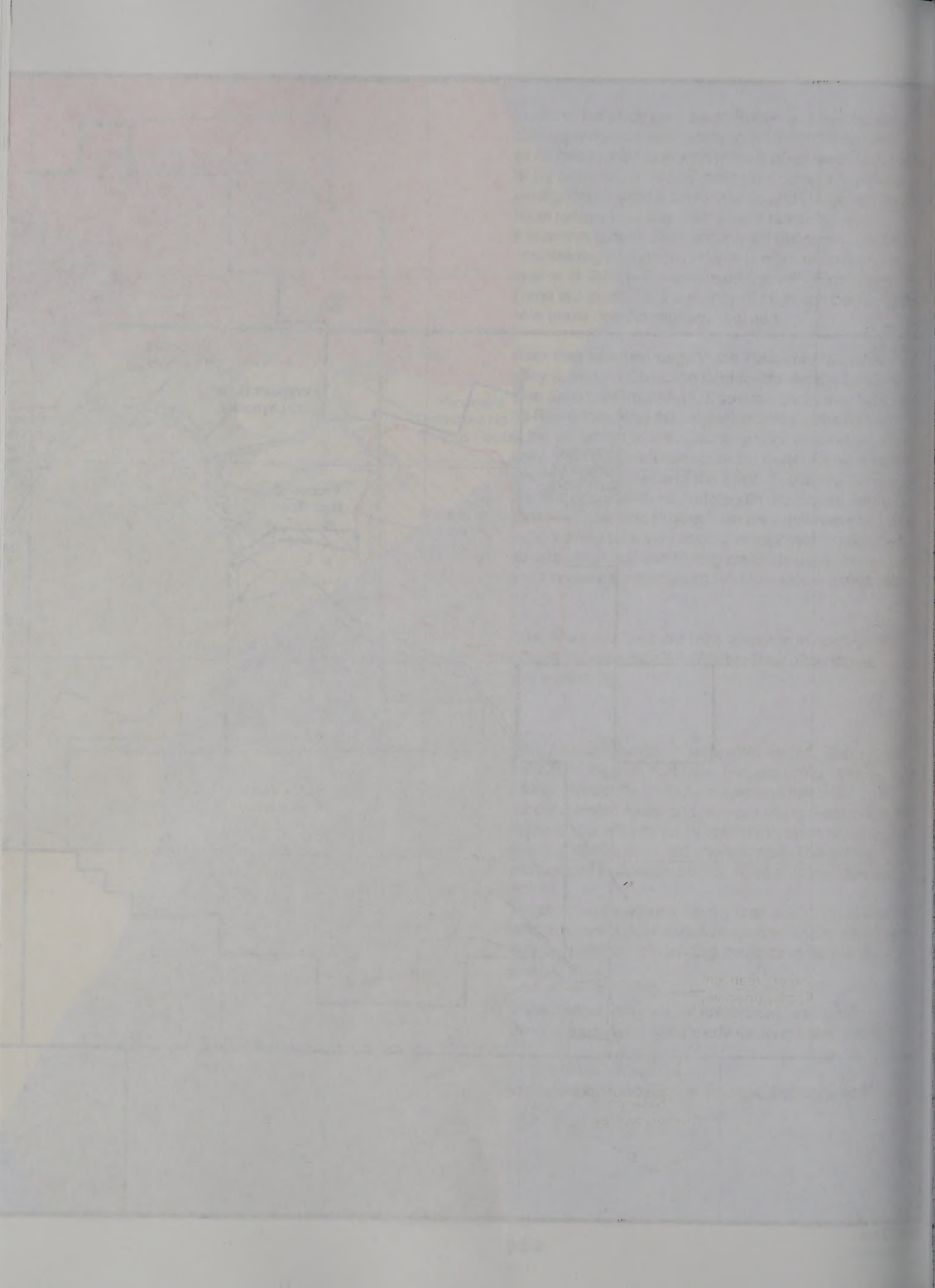
Due to limited habitat, waterfowl or shorebird concentrations are limited to ponds, springs, and perennial streams located in the project region.



Betze Pit Expansion Project

Figure 3.8-1

Pronghorn Habitat



LEGEND
Goldstrike Mine Operations Boundary
Tailings Facility
Pit Expansion
Perimeter Buffer to Laybacks
Waste Rock Facility
Clydesdale Haul Road
Tailings Pipeline
Previous Disturbance
Current Migration Corridors
Historical Migration Corridor
Source: NDOW 2007b, 2008c.
N
0 0.25 0.5 1
Miles
Betze Pit Expansion Project
Figure 3.8-2
Mule Deer Migration Corridors
Elko Co.
Eureka Co.
T 36N, R 48E
T 36N, R 49E
T 35N, R 49E
T 36N, R 50E
T 35N, R 50E
Proposed Goldstrike No. 3 Tailings Facility
North Block Tailings Facility
Mill #4 Tailings Facility
AA Tailings Facility
Process/Support AA Facilities
Leach Pad (Reclaimed)
Meikle Mine Area
Roaster Facility Area
Perimeter Buffer to Laybacks
Pit Laybacks
Betze Pit
Proposed Haul Road
Bazza Waste Rock Facility
Proposed Clydesdale Waste Rock Facility
TS Ranch Reservoir Area 3
Water Treatment Facility (Inactive) 4

3.8.1.3 Nongame Species

A diversity of nongame species (e.g., small mammals, passerines, raptors, and reptiles) occupies a wide range of trophic levels and habitat types within the study area. Habitats found within the study area (e.g. salt-desert shrublands, sagebrush shrublands) support a variety of resident and seasonal nongame species. Nongame mammals include the deer mouse, Merriam's shrew, sagebrush vole, golden-mantled ground squirrel, least chipmunk, and woodrat. Rodent populations provide a large prey base for the area's predators.

Nongame birds encompass a variety of passerine and raptor species including migratory bird species that are protected under the Migratory Bird Treaty Act (MBTA) (16 USC 703-711) and Executive Order (EO) 13186 (66 Federal Register [FR] 3853); see Section 3.8.1.4, Migratory Birds, for further details.

Passerine or songbird species occupy the entire range of habitats found within the study area. However, due to the higher level of plant diversity and structure, more abundant potential nest sites, and greater food base, the riparian areas along Bell, Boulder, and Rodeo creeks support the highest diversity of bird species within the study area.

Several raptor species have been documented within the vicinity of the study area including the golden eagle, prairie falcon, American kestrel, red-tailed hawk, great-horned owl, short-eared owl, and western burrowing owl (Lamp 2007b). Details on sensitive raptor species such as golden eagle, bald eagle, and ferruginous hawk are discussed in the Special Status Bird Species section in Section 3.8.1.5, Special Status Species. Information on other raptors is presented below.

No known raptor nests exist within the study area (Lamp 2007b). Golden eagles have been observed within the study area, but no nests have been recorded in the vicinity. Prairie falcons have been recorded approximately 20 miles southwest of the study area along Rock Creek (Lamp 2007b). Burrowing owls have been recorded nesting approximately 15 miles northwest of the study area along Boulder Creek (Lamp 2007b). Red-tailed hawk and great-horned owl nests were observed in the Ren Pit. There also has been red-tailed hawk nesting in the Dee Pit in the past. This nest had to be removed 2 years in a row to allow for mining to occur in that portion of the pit (Lamp 2007b).

Other important nongame species include several bat species. The study area contains suitable foraging habitat for several bat species (Bradley et al. 2006). All of the bats identified for this study are currently BLM sensitive species and/or Nevada protected species (BLM 2007d; NDOW 2007a). These species are presented in detail in Section 3.8.1.5, Special Status Species.

Other nongame species within the study area include amphibians and reptiles such as the Great Basin spadefoot toad, Great Basin whip-tailed lizard, Great Basin rattlesnake, gopher snake, long-nose leopard lizard, and northern sagebrush lizard (BLM 2002a). Amphibian presence is limited within the study area due to intermittent flows in Bell and Rodeo creeks and a lack of other water sources. The northern leopard frog and spotted frog have been recorded in the CESA; details are discussed in Section 3.6, Aquatic Resources.

3.8.1.4 Migratory Birds

Pursuant to EO 13186, a draft MOU among the BLM, USFS, and USFWS was drafted in order to promote conservation and protection of migrating birds. Specific measures to protect migratory bird species and their habitats have not been identified within EO 13186, but instead, the EO provides guidance to agencies to promote best management practices for the conservation of migratory birds. As a result, the BLM Nevada State Office prepared Migratory Bird BMPs for the Sagebrush Biome in order to assist BLM field offices in the consideration of migratory birds in land management activities (BLM no date).

A wide variety of migratory birds are found within the study area. These species are associated with a variety of habitat types, and many occur within the project vicinity year-round. Details on sensitive species such as short-eared owl, vesper sparrow, and loggerhead shrike are discussed in the following section.

3.8.1.5 Special Status Species

As stated in Section 3.6, Aquatic Resources, special status species are those species for which state or federal agencies afford an additional level of protection by law, regulation, or policy. A total of 42 special status species were identified as potentially occurring within the study area (BLM 2007d; NDOW 2007a; NNHP 2007; USFWS 2007b). These species, their associated habitats, and their potential for occurrence within the study area are summarized in **Appendix E**. Occurrence potential within the study area and CESA was evaluated for each species based on their habitat requirements and/or known distribution. Based on these evaluations, seven special status wildlife species have been eliminated from detailed analyses based on their habitat requirements and/or known distributions, as shown in **Appendix E**. These species include silver-haired bat, river otter, northern goshawk, Lewis's woodpecker, pinyon jay, juniper titmouse, and black-rosy finch. The 36 special status wildlife species identified as potentially occurring within the project area or CESA are described below. The two amphibian special status species identified as potentially occurring within the Project area or CESA are discussed in Section 3.6.1.2, Aquatic Resources Special Status Species.

Special Status Mammal Species

Federal and state sensitive bat species that have been identified as potentially occupying appropriate habitat types within or near the study area are presented in **Appendix E**. Bat species that could occur within the study area include pallid bat, Townsend's big-eared bat, big brown bat, hoary bat, California myotis small-footed myotis, long-eared myotis, little brown myotis, long-legged myotis, Yuma myotis, western pipistrelle bat, and Brazilian free-tailed bat (BLM 2007d; Lamp 2007b; NNHP 2007). Suitable foraging habitat is present throughout the study area (Bradley et al. 2006). Potential roosting habitat within the vicinity of the project boundary includes forested habitat and rock outcrops. Higher elevation forest habitats and cliffs are present east of the study area in the Tuscarora Range and may provide potential roosting habitat for area bats.

Pallid Bat

The pallid bat is a year-round resident in Nevada. Found primarily at low and middle elevations (1,300 to 8,400 feet), this species occupies a variety of habitats such as piñon-juniper, blackbrush, cresote, sagebrush, and salt desert scrub (Bradley et al. 2006). This species feeds primarily on large ground-dwelling arthropods (e.g., scorpions, centipedes, grasshoppers), but also feeds on large moths (Bradley et al. 2006). The pallid bat is a colonial species, roosting in groups of up to 100 individuals (Arizona Game and Fish Department [AGFD] 1993). Roost sites consist of rock outcrops, mines, caves, hollow trees, buildings, and bridges (AGFD 1993; Bradley et al. 2006). The pallid bat is intolerant of roost sites in excess of 40 degrees Celsius (Bradley et al. 2006). This species has been documented southwest of the study area along Rock Creek (Bradley et al. 2006). Based on its known range and suitable habitat within the study area, the potential for this species to occur within the study area is considered high.

Townsend's Big-eared Bat

The Townsend's big-eared bat is a year-round resident found throughout Nevada from low desert to high mountain habitats (700 to 11,400 feet in elevation) (Bradley et al. 2006). The Townsend's big-eared bat primarily occurs in piñon-juniper, mountain mahogany, white fir, blackbrush, sagebrush, salt desert scrub, agricultural lands, and urban habitats (Bradley et al. 2006). This species prefers caves, mines, and buildings that maintain stable temperatures and airflow for nursery colonies, bachelor roosts, and hibernacula (Harvey et al. 1999). It does not make major migrations and appears to be relatively sedentary, not traveling far from summer foraging grounds to winter hibernation sites (Harvey et al. 1999). Its distribution seems to be determined by suitable roost and hibernation sites, primarily caves and mines. This bat is believed to feed entirely on moths (Harvey et al. 1999) and gleans insects from foliage and other surfaces (Bradley et al. 2006). This species has been recorded east of the study area at abandoned mine shafts in the Lynn Creek drainage (BLM 2002b), and NNHP has identified the study area as suitable habitat (NNHP 2007). The potential for this species to occur within the study area is considered high.

Big Brown Bat

The big brown bat is a year-round resident in Nevada. This species is found from low to high elevations (1,000 to 9,800 feet) and occupies a variety of habitats including piñon-juniper, blackbrush, cresote, sagebrush, and salt desert scrub (Bradley et al. 2006). This species gleans insects over water and open landscapes, as well as in both forested and edge settings (Bradley et al. 2006). The big brown bat is a colonial species, roosting in groups up to several hundred. Roost sites include caves, mines, buildings, bridges, and trees. This species is known to be more tolerant of human habitation than other bat species. This species has been documented at several locations in the project vicinity including Sugarloaf Butte (BLM 2000a; Lamp 2007b). The potential for this species to occur within the study area is considered high.

Western Red Bat

In Nevada, previous to 2004, this species was known only from a few locations in Lincoln and Clark counties (Bradley et al. 2006). Audio data, recorded in 2004, determined the presence of western red bat in the vicinity of Newmont's Proposed Emigrant Project 25 miles south of the Betze Pit Expansion Project. It is typically found in wooded areas and lowland riparian areas. The western red bat roosts under tree bark and leaf litter but also may roost in caves and mines (Bradley et al. 2006). Records of this species in Nevada are inconsistent and this species is generally considered a migrant. Suitable habitat for this species occurs within the study area. The potential for occurrence within the project area is considered moderate.

Hoary Bat

The hoary bat is a summer resident in Nevada found at low to middle elevations (1,900 to 8,200 feet) in forest habitats including riparian and upland forests (Bradley et al. 2006). This species also is found in valley basins containing pure stands of Rocky Mountain juniper as well as agricultural areas (Bradley et al. 2006). The hoary bat forages primarily at high altitudes over the tree canopy and follows watercourses for foraging and drinking (Bradley et al. 2006). This species roosts in trees within foliage but may roost in caves and beneath rock ledges (Bradley et al. 2006). This species has not been documented within the project vicinity. Marginal foraging habitat occurs within the study area. The potential for this species to occur within the study area is considered low.

California Myotis

The California myotis is a year-round resident found throughout Nevada at low and middle elevations (700 to 9,000 feet) (Bradley et al. 2006). This species occurs in a variety of habitats from Lower Sonoran desert scrub to forests. The California myotis gleans insects above open habitat. This species typically roosts singly or in small groups, although some mines are known to shelter colonies of over 100 individuals. Roost sites include mines, caves, buildings, rock crevices, hollow trees, and under exfoliating bark (Bradley et al. 2006). This species is known to forage throughout the winter. This species has not been documented within the project vicinity. However, suitable foraging habitat occurs within the project region. The potential for this species to occur within the study area is considered high.

Small-footed Myotis

The small-footed myotis is found throughout Nevada from approximately 3,500 to 5,900 feet in elevation (Bradley et al. 2006). This species inhabits a variety of habitats including desert scrub, grassland, sagebrush steppe, blackbrush, greasewood, piñon-juniper woodlands, pine-fir forests, agricultural lands, and urban areas (Bradley et al. 2006). Day and maternity roosts of western small footed myotis have been found in crevices in cliffs, boulders, and on talus slopes. Summer roosts are highly variable and include buildings, mines, under the bark on trees, and crevices in cliffs and boulders (AGFD 1993; Harvey et al. 1999). This species prefers small protected dry crevices. Night and hibernation roosts are located in small caves and abandoned mine adits. Buildings also are used as temporary night roosts between flights. Western small-footed myotis forage for insects over the edge of rocky bluffs, in clearings, near rocks, and over forests (AGFD 1993; Bradley et al. 2006; Harvey et al. 1999). This species has been documented within the Newmont Operations Area south of the study area (Lamp 2007b). Suitable foraging habitat occurs within the study area. The potential for this species to occur within the study area is considered high.

Long-eared Myotis

The long-eared myotis is found throughout Nevada from approximately 2,300 to 6,800 feet in elevation but primarily is found at higher elevations (Bradley et al. 2006). The long-eared myotis primarily is associated with coniferous forests, including piñon-juniper woodlands, however, the species also utilizes sagebrush and desert scrub habitats. Day roosts include hollow trees; under loose tree bark; crevices in rock cliffs and fissures in the ground; and occasionally in caves, abandoned mines, and buildings. Night roosts primarily occur in caves, mines, and abandoned buildings (AGFD 1993; Bradley et al. 2006; Harvey et al. 1999). This species is known to roost singly or in small groups. This species gleans insects (primarily small moths) over vegetation and open water (e.g., rivers, streams, and ponds) (Bradley et al. 2006). This species has been documented within the project vicinity at Sugarloaf Butte and along Rock Creek (BLM 2000b; Bradley et al. 2006; Lamp 2007b). Suitable foraging habitat occurs within the study area. The potential for this species to occur within the study area is considered high.

Little Brown Myotis

The little brown bat is probably a year-round resident primarily found in northern Nevada at higher elevations. This species often is associated with coniferous forests. Foraging occurs in open areas among vegetation, along water margins, and above open water. Roost sites include hollow trees, rock outcrops, buildings, and occasionally in mines and caves (Bradley et al. 2006). This species has not been documented within the project vicinity. Marginal foraging habitat occurs within the study area. The potential for this species to occur within the study area is considered low.

Long-legged Myotis

The long-legged myotis occupies piñon-juniper and montane coniferous forest habitats from approximately 3,000 to 11,200 feet in elevation in Nevada (Bradley et al. 2006). Individuals typically day roost singly or in small groups in buildings, rock crevices, caves, abandoned mines, or in hollow trees, particularly large diameter snags or live trees with lightning scars (AGFD 1993; Bradley et al. 2006; Harvey et al. 1999). Night roosts and hibernacula are often in caves and mines. Foraging typically occurs in open areas, often at canopy height (Bradley et al. 2006). This species has been documented within the project vicinity at Sugarloaf Butte (Lamp 2007a). Suitable foraging habitat occurs within the study area. The potential for this species to occur within the study area is considered high.

Yuma Myotis

The Yuma myotis is a year-round resident found primarily in the southern and western half of Nevada at low to middle elevations (1,500 to 7,700 feet). This species occurs in a wide variety of habitats, including sagebrush, salt desert scrub, agriculture, playa, and riparian habitats. This species gleans aquatic insects over open water and above vegetation. Roost sites include buildings, trees, mines, caves, bridges, and rock crevices. Night roosts are usually associated with buildings, bridges, or other man-made structures (Bradley et al. 2006). This species has not been documented within the project vicinity. Suitable foraging habitat occurs within the study area. The potential for this species to occur within the study area is considered moderate.

Western Pipistrelle Bat

The western pipistrelle is a year-round resident in Nevada, occupying low and middle elevations (700 to 8,200 feet) in desert habitats of blackbrush, creosote, salt desert scrub, and sagebrush, with occasional occurrence in ponderosa pine and piñon-juniper, usually in association with rock features such as granite boulders and canyons (Bradley et al. 2006). This species gleans insects over open habitats. This species roosts both singly or in small groups in mines, caves, or occasionally in buildings and vegetation. This species has been documented within the project region along Rock Creek (BLM 2000a; Bradley et al. 2006). Suitable foraging habitat occurs within the study area. The potential for this species to occur within the study area is considered high.

Brazilian Free-tailed Bat

The Brazilian free-tailed bat is found throughout Nevada in a wide variety of habitats ranging from desert scrub to high elevation mountain habitats (700 to 8,200 feet) (Bradley et al. 2006). This species roosts in a variety of structures including cliff faces, caves, mines, buildings, bridges, and hollow trees. Some caves are used as long-term transient stopover roosts during migration (Bradley et al. 2006). The Brazilian free-tailed bat is known to travel long distances to foraging areas and often forages at high altitudes. This species has not been documented within the project vicinity. Suitable foraging habitat occurs within the study area. The potential for this species to occur within the study area is considered moderate.

Preble's Shrew

The Preble's shrew is found in a wide variety of habitats in Nevada including arid grasslands and shrublands, wetland and forest edges, and alpine tundra. The Preble's shrew is active year-round and may be active at any time throughout the day or night, but is probably most active during morning and evening hours (WAPT 2006). The Preble's shrew resembles other shrews, feeding primarily on insects and other small invertebrates such as worms, mollusks, and centipedes (WAPT 2006). The Preble's shrew has been documented in northern Elko County, and suitable habitat occurs within the study area (BLM 2002b). The potential for this species to occur within the study area is considered high.

Pygmy Rabbit

This species has been recorded south of the study area at the Leeville Project (BLM 2002b). The pygmy rabbit is distributed throughout the northern Great Basin, primarily in rocky habitats dominated by dense stands of big sagebrush and rabbitbrush, particularly in floodplain habitats. Pygmy rabbits usually remain near dense cover, where rabbits excavate burrows and create trail systems in the understory. Sagebrush is important forage for this rabbit and is consumed year-round. NNHP (2007) has identified the study area as having suitable sagebrush habitat. Field surveys by BGMI in March 2008, found suitable habitat present in the study area but no evidence of new use (SRK 2008a); therefore, the potential for this species to occur within the study area is considered moderate.

Fletcher Dark Kangaroo Mouse

This species is found throughout Nevada in a wide variety of habitats including intermountain desert scrub, sagebrush grasslands, badlands, desert playas, and ephemeral pools (WAPT 2006). This species' primary food source is seeds, but it also may eat insects. It does not appear to utilize free water and is believed to store food in seed caches within burrow systems (WAPT 2006). Activity for this species has been observed March to October with peak nocturnal activity occurring in the first 2 hours after sunset (WAPT 2006). Suitable habitat occurs within the study area. The potential for this species to occur within the study area is considered high.

Special Status Bird Species

Least Bittern

The least bittern is found in wetlands, marshes, wet meadows, and lakes from Sheldon National Wildlife Refuge (NWR) to Ruby Lakes NWR south to Mason Valley Wildlife Management Area (WMA) in western Nevada (Neel 1999). This species' preferred habitat is marshes in very fresh water, typically characterized by cattail and/or spikerush (Floyd et al. 2007). The breeding season for this species is April 15 to July 15 depending on water conditions. The potential for this species to occur within the study area is considered low.

Bald Eagle

The bald eagle is found throughout Nevada but mainly as a migrant and winter resident (Floyd et al. 2007). This species generally roosts in close proximity to large water bodies including rivers, lakes, and reservoirs (WAPT 2006). Nests are typically very large stick nests located in large trees such as cottonwoods. Bald eagles typically begin nesting in February, and young fledge by July. This species has been documented during winter surveys within the sub-basins of Rock, Boulder, and Maggie Creek (JBR 1996). However, due to

the lack of suitable habitat (i.e., large trees near water bodies), the potential for this species to occur within the study area is considered moderate.

Swainson's Hawk

The Swainson's hawk is a summer resident of Nevada and, like the golden eagle, is most abundant in the northern third of the state (Herron et al. 1985). The majority of documented breeding territories in Nevada have been located in agricultural valleys. Swainson's hawks nest in a wide variety of vegetative communities from 4,000 to 6,500 feet in elevation. Nest sites primarily are found in deciduous trees. However, nests also have been documented in other vegetation types such as buffaloberry, serviceberry, and sagebrush (Herron et al. 1985). Swainson's hawks begin nesting in April, and young typically fledge by July. This species has been observed nesting within the project region (BLM 2002b). No known nest sites occur within the study area (Lamp 2007b). Suitable foraging habitat is located within the study area. The potential for this species to occur within the study area is considered high.

Ferruginous Hawk

The ferruginous hawk commonly breeds in many areas of Nevada. This species often nests in trees, on promontory points, rocky outcrops, cut banks, or on the ground. Preferred breeding habitat in most of the state is scattered juniper forests at the interface between piñon-juniper and desert shrub communities that overlook broad valleys used for foraging (Herron et al. 1985). Ferruginous hawks begin nesting in March, and young fledge by July. This species has been observed nesting within the project vicinity (BLM 2002b). No known nest sites occur within the study area (Lamp 2007b). Suitable foraging habitat occurs within the study area. The potential for this species to occur within the study area is considered high.

Golden Eagle

The golden eagle is a year-long resident and is considered to be commonly breeding throughout Nevada; however, eagle densities and nesting activity are greatest in the northern third of Nevada (Herron et al. 1985). Nesting golden eagles prefer suitable cliffs that overlook sagebrush flats, piñon-juniper forests, salt desert shrub, or other habitat capable of supporting a suitable prey base. Highest densities of nesting eagles typically are found along river systems where cliffs border the entire length of the river, and lower densities are found in piñon-juniper habitat and salt desert shrub communities (Herron et al. 1985). Golden eagles begin nesting in March, and young fledge by July. Wintering golden eagles tend to congregate in broad valleys interspersed with agricultural croplands or sagebrush and desert shrub communities. This species has been recorded flying over the study area and suitable nesting habitat exists approximately 20 miles southwest of the study area (Lamp 2007b). Suitable foraging habitat exists within the study area. The potential for this species to occur within the study area is considered high.

Peregrine Falcon

The peregrine falcon is found in southwestern and extreme southeastern Nevada. This species prefers tall cliffs with an unobstructed view for both nesting and perching. Peregrine falcons nest on cliffs and rock ledges usually in close proximity to a water source (Johnsgard 1990). This species typically migrates south of the U.S. during winter months. Peregrine falcons forage in open areas for birds and occasionally small mammals (Johnsgard 1990). Although previous surveys have not observed this species, there is marginal foraging habitat located within the study area. However, no known nest sites occur within or near the study area. The potential for this species to occur within the study area is considered low.

Prairie Falcon

Prairie falcons range throughout the Great Basin and are permanent residents of Nevada. Habitat requirements include steep cliff ledges and outcrops for nesting that border semi-arid valleys (BLM 2005). The highest nesting densities in Nevada occur in northern counties, particularly located in or near the mouth of narrow canyons, overlooking riparian vegetation and agricultural lands (Herron et al. 1985). Prairie falcons begin nesting in March, and young typically fledge by July. This species has been recorded flying over the study area (Lamp 2007b). Suitable foraging habitat occurs within the study area, and nesting habitat occurs

approximately 20 miles southwest of the study area. The potential for this species to occur within the study area is considered high.

Greater Sage-grouse

The greater sage-grouse is found throughout Nevada in sagebrush-dominated habitats (Northeastern Nevada Stewardship Group [NNSG] 2004). Sagebrush is a key component of greater sage-grouse habitat on a year-long basis (NNSG 2004; USFWS Mountain Prairie Region [USFWS MPR] 2007). Sagebrush provides forage and nesting, security, and thermal cover for this species. Moist areas that provide succulent herbaceous vegetation during the summer months are used extensively as brood rearing habitat. Open, often elevated areas within sagebrush habitats usually serve as breeding areas (strutting grounds or lek sites) (NNSG 2004; USFWS MPR 2007). During winter, greater sage-grouse often occupy wind exposed areas where sagebrush is available (e.g., drainages, southern or western slopes, or exposed ridges). Historically, three leks occurred immediately within the project vicinity (Lamp 2007b). However, two of these leks have been consumed by the BGMI Goldstrike Mine in recent years. The third lek is 1.5 miles north of the study area and has not been active since 1989 (BLM 2007b). The nearest active lek occurs approximately 5.5 miles north of the study area and is considered in the cumulative effects analyses. Greater sage-grouse males begin displaying on leks in March, and hens typically begin nesting in April and May. NDOW considers the entire project area summer and winter habitat (Lamp 2007b). **Figure 3.8-3** presents designated sage-grouse nesting habitat in the vicinity of the study area. Greater sage-grouse have been observed within the project area and suitable habitat is present. However, surveys conducted in March 2008 found little sign and indicated the project area as low density habitat (SRK 2008b). Considering that the study area encompasses three historic leks and greater sage-grouse have been observed in the study area, the potential for this species to occur within the study area is high.

Sandhill Crane

The sandhill crane breeds in the lower river valleys and interior basins of the northeastern and east-central regions of Nevada (Floyd et al. 2007). This species is found in large irrigated hay meadows, flooded pastures, and grasslands (WAPT 2006). Sandhill cranes also are found in agricultural grain fields during certain times of the year. Approximately 90 percent of nesting crane pairs in Nevada are found in Elko County with additional nesting pairs in White Pine, Eureka, Lander, northern Lincoln and Nye, and eastern Humboldt counties (WAPT 2006). The breeding season for this species is April 15 to July 15. Due to the lack of suitable habitat, the potential for this species to occur within the study area is considered low.

Long-billed Curlew

The long-billed curlew is known to breed at Sheldon NWR in northern Washoe County, Ruby Lake NWR in Elko County, Lahontan Valley in Churchill County, and Fish Creek Ranch in Eureka County. This species prefers short grasslands, wet meadows, wetlands, and marshes (Floyd et al. 2007). The breeding season for this species is April 15 to July 15. Due to marginal habitat occurring within the study area, the potential for this species to occur within the study area is considered low.

Black Tern

The black tern is found only at a few locations in Nevada including shallow lakes and wetlands from Sheldon NWR to Ruby Lakes NWR south to Mason Valley WMA in western Nevada (Floyd et al. 2007). This species prefers marshes in very fresh water, typically characterized by cattail and/or spikerush. Nesting usually occurs semicolonially with other terns in shallow freshwater marshes with emergent vegetation (Floyd et al. 2007). The breeding season for this species is April 15 to July 15. The potential for this species to occur within the study area is considered low.

Burrowing Owl

The burrowing owl is known to breed throughout Nevada. The majority of the breeding population is known to migrate from northern Nevada during the winter months. However, observations of this owl have been recorded throughout Nevada during all months of the year (Herron et al. 1985). Breeding by burrowing owls is

Betze Pit Expansion Project

Figure 3.8-3

Greater Sage-grouse Historical Habitat

strongly dependent on the presence of burrows constructed by prairie dogs, ground squirrels, or badgers. Prime burrowing owl habitat must be open, have short vegetation, and contain an abundance of burrows. Burrowing owls begin nesting in April, and young typically fledge by August. This species has been observed nesting approximately 15 miles northwest of the study area (Lamp 2007b). No known nest sites occur within the study area. Suitable foraging habitat exists within the study area. The potential for this species to occur within the study area is considered high.

Long-eared Owl

Long-eared owls occur within juniper woodlands, coniferous forests, and riparian areas at higher elevations (Herron et al. 1985). The majority of Nevada's population of long-eared owls is considered non-migratory, although individuals occurring outside of Nevada have been known to winter in Nevada (Herron et al. 1985). Long-eared owls begin nesting in February, and young typically fledge by July. This species has been documented within the project region south of the study area in Boulder Valley. Suitable foraging habitat occurs within the study area. Due to a lack of roosting and nesting habitat, the potential for this species to occur within the study area is considered low.

Short-Eared Owl

Short-eared owls are year-round residents of Nevada, although few nest sites have been identified. The species tend to nest in meadow and wetland habitats (Herron et al. 1985). Short-eared owls forage in open areas and are known to nest and roost on the ground. This species begins nesting in February, and young typically fledge by July. This species has been documented within the project region south of the study area in Boulder Valley and in Squaw Valley at the northern end of the Carlin Trend (JBR 1996). Suitable nesting and foraging habitat occurs within the study area. The potential for this species to occur within the study area is considered high.

Loggerhead Shrike

The loggerhead shrike is a common resident throughout Nevada. This species is found in open grasslands along valley floors and foothills of the Great Basin. In Nevada, it is commonly found in scrub habitat types such as sagebrush and greasewood. Loggerhead shrikes prefer shrubs or small trees for nesting, but nesting also can occur in piñon-juniper woodlands. The breeding season for this species is April 15 to July 15. This species can be found perching on wire, fences, or poles (National Geographic Society 1983). This species has been observed within the project region (BLM 2002b). There is suitable nesting and foraging habitat within the study area. The potential for this species to occur within the study area is considered high.

Yellow-breasted Chat

The yellow-breasted chat is found throughout Nevada, although it is more common in the eastern portion of the state (Floyd et al. 2007). This species is found in cottonwood, willow, riparian and other woodland habitats with dense understories. The breeding season for this species is April 15 to July 15. Due to the lack of suitable habitat, the potential for this species to occur within the study area is considered low.

Vesper Sparrow

The vesper sparrow is a summer resident that occurs in various open shrub habitats from high elevation valleys to higher mountain slopes and basins (Floyd et al. 2007). This species occurs from approximately 5,500 feet in elevation in the foothills of northern Nevada to approximately 9,000 feet in elevation in surrounding mountain ranges. Open areas with a scattered canopy of big sagebrush and a minimum ground cover of 20 percent grasses, forbs, and young shrubs appear to be the preferred nesting habitat for this species (Floyd et al. 2007). Nests normally are placed on the ground under or near shrubs. The breeding season for this species is April 15 to July 15. Diet consists of seeds and insects (Neel 1999). There is suitable nesting and foraging habitat within the study area. The potential for this species to occur within the study area is considered high.

3.8.2 Environmental Consequences

Wildlife, special status species, and related issues addressed by this analysis were determined through consultation with the BLM, NDOW, and USFWS. The primary issues related to wildlife and special status species include: disruption of big game movements and cumulative loss of habitat, loss or alteration of native habitats, increased habitat fragmentation, animal displacement, direct loss of wildlife, and impacts associated with water management. In addition, primary issues related to special status species, especially pygmy rabbit and greater sage-grouse, include impacts that could contribute to their being listed as federally threatened or endangered.

The potential impacts of the proposed project on terrestrial wildlife can be classified as short-term and long-term. Short-term impacts arise from habitat removal and disturbance as well as from activities associated with mine operation; these impacts would cease upon mine closure and completion of successful reclamation. Long-term impacts consist of permanent changes to habitats and the wildlife populations that depend on those habitats, irrespective of reclamation success. Direct impacts to wildlife populations could include limited direct mortalities from mine development, habitat loss or alteration, incremental habitat fragmentation, and animal displacement. Indirect impacts could include increased noise, additional human presence, and the potential for increased vehicle-related mortalities.

The riparian habitat within the region supports a greater number of species than other habitat types. As a result, project-related effects may be greater for species closely associated with riparian corridors. The degree of the effects on terrestrial wildlife species and their upland habitats would depend on factors such as the sensitivity of the species, seasonal use patterns, type and timing of project activity, and physical parameters (e.g., topography, cover, forage, and climate).

3.8.2.1 No Action Alternative

Under the No Action Alternative, the Goldstrike Mine would continue to operate under existing authorizations. No native wildlife habitat would be disturbed or lost. Additional habitat fragmentation and animal displacement would not occur. The level of human use would remain the same as the current levels.

Surface Disturbance

Impacts to wildlife from currently authorized mine-related surface disturbance include the temporary (short-term and long-term) and permanent reduction or loss of habitat (BLM 1991b). Habitat loss or alteration results in direct losses of smaller, less mobile species of wildlife, such as small mammals and reptiles, and the displacement of more mobile species into adjacent habitats. In areas where habitats are at, or near, carrying capacity, animal displacement could result in some unquantifiable reductions in local wildlife populations (BLM 1991b). Mine-related surface disturbance also results in an incremental increase in habitat fragmentation at the mine site until reclamation has been completed and vegetation has been re-established (BLM 1991b). It is assumed that mine-related displacement and habitat fragmentation effects are highest for wildlife species that use riparian corridors (BLM 1991b).

Game Species

Direct impacts to mule deer include the long-term reduction of potential forage and the increase of habitat fragmentation from vegetation removal associated with mine construction and development activities (BLM 1991b). This loss of habitat has resulted in an overall reduction in the amount of available habitat in the project region. In addition, an important big game migration corridor located along the west side of the Tuscarora Range has been directly impacted from the construction of several large mining facilities including the Goldstrike Mine (Lamp 2007b). These facilities have severely decreased the width of the migration corridor and further fragmented mule deer habitat along the Carlin Trend (Lamp 2007b).

Impacts to pronghorn would be similar to those discussed above for mule deer, although not as severe based on pronghorn population trends and use within the study area.

Impacts to mountain lions are minimal, based on the infrequent occurrence of the species within the study area.

Direct impacts to small game species (e.g., greater sage-grouse, chukar, mourning dove, pygmy rabbit, and black-tailed rabbit) include the long-term reduction of potentially suitable habitat and the permanent loss of potential habitat (BLM 1991b). Existing impacts also include displacement from the disturbance areas and increased habitat fragmentation, until reclamation has been completed and vegetation is re-established. In most instances, suitable habitat adjacent to disturbance areas is available for use by these species. However, displacement increases competition and could include some local reductions in wildlife populations if adjacent habitats are at carrying capacity (BLM 1991b).

Nongame Species

Impacts to nongame species are similar to those discussed above for small game species. Existing direct impacts to nongame species (e.g., small mammals, passerine, raptors, and reptiles) include the long-term reduction of suitable habitat, permanent loss of habitat, and the direct loss of less mobile species (BLM 1991b). Existing impacts also include displacement from the disturbance areas and increased habitat fragmentation until vegetation is re-established. However, displacement increases competition and results in some local reductions in wildlife populations if adjacent habitats are at carrying capacity (BLM 1991b). Existing impacts also include nest and burrow abandonment or loss of eggs or young.

Human Presence and Noise

Under currently authorized disturbance, impacts resulting from human presence and noise include avoidance or accommodation. Avoidance results in displacement of animals from an area larger than the actual disturbance area. The total extent of habitat loss as a result of the wildlife avoidance response is impossible to predict since the degree of this response varies from species to species and can even vary between different individuals of the same species. In addition to avoidance response, increased human presence has intensified the potential for wildlife/human interactions ranging from harassment of wildlife to poaching and legal harvest. No additional impacts would be expected under this alternative.

Water Quality and Quantity

Species likely affected by reductions in available water sources and associated habitats would include big game, upland game birds and small game mammals, nongame birds (e.g., raptors and passerines), nongame mammals (e.g., bats), reptiles, amphibians, and fish. The impacts to these species are included within the area that was disclosed and mitigated for in the 2000/2003 Betze SEIS (BLM 2000a, 2003a) as shown in **Figure 3.3-48** and described in Section 3.3.3.1 and 3.3.4.2.

The CIA (BLM 2000b) and Betze Project Draft SEIS (BLM 2000a) summarized the impacts associated with future reduction in mine discharges on the artificially created wetlands in Boulder Valley. As mine discharges diminish in the future, the level of free water that has surfaced within the valley, in addition to the associated riparian and wetland vegetation, would be reduced. Waterfowl/shorebirds use of these artificial communities could also decline as drier habitats begin to reestablish in the valley. Based on anecdotal observations of the soils and vegetation in this area, it appears that saturated soils are increasing the leaching of minerals and salts into the soil surface and subsurface layers, thereby modifying the associated plant communities (BLM 2000a, 2000b). The leaching of minerals and salts also may be occurring on irrigated lands in Boulder Valley. As mine dewatering diminishes and artificial wetlands dry out, other impacts may occur such as an increase in: 1) noxious and invasive plant species, 2) susceptibility to wildfire, 3) eolian erosion and fugitive dust emissions if upland plants do not become reestablished, and 4) saline or alkaline runoff.

These potential impacts would affect private land in Boulder Flat primarily within the TS Ranch controlled by ELLCO, a subsidiary of Newmont Gold Corporation. These lands are not under BLM jurisdiction or BGMI's control. Irrigated lands within Boulder Flat may continue to be irrigated after mine dewatering diminishes. ELLCO has water rights to allow for pumping groundwater for irrigation to supplement or replace the water supply provided by BGMI after mine dewatering ceases at the Goldstrike Mine.

The BLM cannot enforce mitigation for potential impacts on private land; however, the BLM recommends the following voluntary measures for private landowners to implement should they choose to mitigate for potential impacts on artificial wetland sites and irrigated areas that have dried out due to cessation of mine dewatering in Boulder Flat:

- Conduct vegetation monitoring at affected sites to determine vegetative cover, species density, and diversity and compare results to suitable reference areas in Boulder Flat.
- Implement a noxious and invasive weed control program, including weed surveys, to minimize their spread and reduce wildfires associated with cheatgrass infestations.
- Mitigation of soil salinity in affected areas by:
  - Reclamation (removal of salts from the root zone that requires large quantities of freshwater and effective soil drainage); or
  - Scraping and removal of surface soils that contain salt buildup; or
  - Incorporation of organic matter to improve soil structure and water infiltration; or
  - Deep tillage to mix salts present in the surface zone with deeper soils to reduce surface concentrations.
- Conduct vegetation reseeding with appropriate plant species in affected areas to minimize wind and water erosion as well as fugitive dust. Plant appropriate salt-tolerant vegetation in areas that have salt or alkali buildup in soils.

3.8.2.2 Proposed Action

Terrestrial Wildlife

Surface Disturbance

The Proposed Action would result in the long-term reduction of approximately 943 acres of native vegetation, including approximately 867 acres of sagebrush shrubland. Woody species such as sagebrush would require up to 25 years to reach maturity. The disturbance associated with the Proposed Action would be reclaimed following completion of mining activities. BGMI would conduct reclamation monitoring in the same manner as the AA Leach Pad and Bazza Waste Rock Facility as it has been confirmed to be successful reclamation as compared to adjacent undisturbed sites (Cedar Creek Associates 2007a).

Impacts to wildlife from mine-related surface disturbance would include the temporary (short-term and long-term) and permanent reduction or loss of habitat. Habitat loss or alteration would result in direct losses of smaller, less mobile species of wildlife, such as small mammals and reptiles, and the displacement of more mobile species into adjacent habitats. In areas where habitats are at, or near, carrying capacity, animal displacement could result in some unquantifiable reductions in local wildlife populations. Mine-related surface disturbance also would result in an incremental increase in habitat fragmentation at the mine site until reclamation has been completed and vegetation has been re-established. It is anticipated that the potential mine-related displacement and habitat fragmentation effects would be highest for wildlife species that use the riparian corridors along Bell, Boulder, and Rodeo creeks. However, BGMI proposes to implement a 100-foot setback from Bell and Rodeo creeks when constructing the Clydesdale Waste Rock Facility, therefore, limiting impacts to species associated with this riparian corridor.

Game Species

Potential direct impacts to mule deer would include the incremental long-term reduction of potential forage and the incremental increase of habitat fragmentation from vegetation removal associated with mine construction and development activities. The project would disturb approximately 943 acres of low density mule deer habitat, consisting primarily of sagebrush shrublands habitat. This anticipated loss of habitat would result in an incremental reduction in the amount of available habitat in the project region. In addition, NDOW has indicated

that an important historic big game migration corridor located along Bell Creek would be directly impacted from the construction of the proposed Clydesdale Waste Rock Facility (Lamp 2007b; NDOW 2007b). This waste rock facility would decrease the width of the migration corridor and would further fragment mule deer habitat along the Carlin Trend. Therefore, significant impacts to mule deer populations that continue to use this important historic migration corridor could occur as a result of the Proposed Action (Lamp 2007c).

In order to minimize continuing impacts to the transition range for the resident mule deer herd, BGMI is committed to minimizing disturbance where possible within the remaining corridors that are utilized by the deer herd for passage through the Carlin Trend area. Surface disturbance would be staged in such a way, where possible, as to be sequential in nature; if one part of an open corridor is disturbed it would be completed and reclaimed before a subsequent section is started. The corridor would be maintained at a width of 600 feet. **Figure 2-15** shows the reclamation schedule for the Clydesdale Waste Rock Facility along the corridor.

Construction of the Clydesdale Waste Rock Facility and associated haulage road would progress using the following protective measures:

- The footprint of the entire facility and haul road would be surveyed in the field. Appropriate storm water controls would be designed and installed on the downstream side of the facilities with particular attention being paid to areas adjacent to drainages. An interceptor berm or ditch may be installed on the upstream side of the footprint to minimize the run-on of meteoric water from the adjacent area to the disturbed footprint.
- Disturbance within remaining corridors would be reclaimed as soon as possible to allow the least amount of time for disruption to herd movement.
- Following the construction of the storm water controls, the entire footprint would be stripped of topsoil which would either be staged in a topsoil stockpile or at the toe of the designed facility.
- Culverts would be installed in the Bell Creek Drainage and an engineered fill would be placed to contain and support them.
- The haul road sub base and capping material would be placed by end-dumping material with the mine haulage fleet. Once the haul road is completed, waste rock would be placed within the footprint of the facility, progressing from the entry point of the haul road, building the facility generally to the west and south. The haul road would be constructed with two strategically placed breaks/gaps to allow for wildlife movement to help minimize wildlife/vehicle collisions along the haul road.
- Re-sloping and reclamation of the faces shown in **Figure 2-15** would commence as soon as is practical from a sequencing and worker safety standpoint.
- Facility reclamation would generally be performed once the initial lift of material is placed, which would range from 0 feet at the topographic catch point to approximately 50 feet in height to the south. There would be no irreversible topography changes that would block or hinder movement after mining activities are completed. Reclaimed topography would support north/south deer patterns of migration.
- The Bazza Waste Rock Facility has been partially reclaimed in previous years along its western margin closest to the Bell Creek Drainage. Subsequent reclamation on the Bazza Waste Rock facility would concentrate on continuing to expand this western margin to allow the migration corridor to widen in the least amount of time possible.

BGMI has committed to assisting NDOW and the BLM in the collection of big game migration data in the project vicinity. BGMI has contributed approximately $31,849 for the purchase of 5 radio collars to monitor how mining, fire, and other influences are impacting the Area 6 deer herd. The use of these radio collars will help NDOW ascertain the continued use of this historic migration corridor and project how it may be used in the future. If the data collected by these collars indicates a reduced use and/or probable abandonment of this corridor than restrictions and commitments imposed upon BGMI for the maintenance of this migration route may be eased or removed.

Impacts to pronghorn would be similar to those discussed above for mule deer. Potential direct impacts would include the incremental long-term reduction of approximately 66 acres of summer range and 360 acres of very important winter range. Although impacts to the pronghorn population would be anticipated from the construction of the Clydesdale Waste Rock Facility, it is anticipated that impacts would not be as severe as those discussed above for mule deer, as pronghorn are able to adjust their migration habits more readily than mule deer.

Impacts to mountain lions are expected not to be significant, as this species occurs at a low density in and around the project area.

Direct impacts to small game species (e.g., chukar, mourning dove, and black-tailed rabbit) would include the incremental long-term reduction of approximately 943 acres of potentially suitable habitat, and the permanent loss of approximately 101 acres of potential habitat. Impacts also would include displacement from the disturbance areas and increased habitat fragmentation, until reclamation has been completed and vegetation is re-established. In most instances, suitable habitat adjacent to disturbance areas would be available for use by these species. However, displacement would increase competition and could include some local reductions in wildlife populations if adjacent habitats are at carrying capacity. Potential impacts also could include nest and burrow abandonment or loss of eggs or young. However, potential effects to small game from mine development are expected to be low. These temporary losses would reduce productivity for that breeding season. Potential impacts to the pygmy rabbit and greater sage-grouse are discussed below.

Nongame Species

Impacts to nongame species would be similar to those discussed above for small game species. Direct impacts to nongame species (e.g., small mammals, passerine, raptors, and reptiles) would include the incremental long-term reduction of approximately 943 acres of potentially suitable habitat, and the permanent loss of approximately 101 acres of potential habitat. Impacts also would include displacement from the disturbance areas and increased habitat fragmentation, until vegetation is re-established. In most instances, suitable habitat adjacent to disturbance areas would be available for use by these species. However, displacement would increase competition and could result in some local reductions in wildlife populations if adjacent habitats are at carrying capacity. Potential impacts also could include nest and burrow abandonment or loss of eggs or young. However, potential effects to nongame species from mine development are expected to be low. These temporary losses would reduce productivity for that breeding season.

Migratory Birds

A variety of resident and migratory bird species (e.g., raptors and songbirds) have been identified as potentially occurring within the study area. Potential direct adverse impacts to bird species would include the temporary loss of approximately 943 acres and permanent loss of approximately 101 acres of potentially suitable breeding, roosting, and foraging habitat. However, this temporary loss is expected to have little effect on local bird populations based on the amount of suitable breeding and foraging habitat in the surrounding area. If construction or development of the proposed facilities was to occur during the breeding season (approximately April 15 through July 15, depending on species), direct impacts to breeding birds could include the possible direct loss of nests or indirect effects (e.g., abandonment) from increased human noise and human presence within close proximity of an active nest site. In order to minimize impacts to breeding raptors, BGMI has committed to conducting breeding raptor surveys and implementing appropriate mitigation measures, as needed, in the event that project construction would occur during the raptor breeding season. In addition, for the protection of breeding songbirds, BGMI has committed to avoiding habitat removal, to the extent possible, between April 15 and July 15 or, alternately, conducting breeding bird surveys and implementing appropriate mitigation in coordination with the BLM and NDOW. With implementation of these measures, residual impacts to nesting bird species within the study area would be limited primarily to temporary habitat loss. This loss is anticipated to have little effect given the extent of native habitats in the surrounding region.

A short segment (<2 miles) of an existing 120-kV transmission line would be re-routed around the proposed Clydesdale Waste Rock Facility (as described in 2.3.5.5). This short, rerouted power line segment is 9,500 feet long and potentially could pose an electrocution hazard for raptor species attempting to perch on the structures. To minimize this potential impact, BGMI has committed to using raptor-deterring design measures which may include, but would not be limited to, a 60-inch separation between conductors and/or grounded hardware in eagle-use areas as well as the use of insulating or cover up materials for perch management depending on line configuration, pole type, and associated biological risk factors. The rerouted power line segment also would incrementally increase the collision potential for migrating and foraging bird species. However, collision potential typically is dependent on variables such as the location in relation to high-use habitat areas (e.g., nesting, foraging, and roosting), line orientation to flight patterns and movement corridors, species composition, visibility, and line design (APLIC 2006). To minimize potential collision impacts to migrating and foraging bird species, BGMI has committed to using standard raptor-proofing designs as discussed in Section 2.2.1.13, Applicant-committed Environmental Protection Measures.

Human Presence and Noise

The most common wildlife responses to noise and human presence are avoidance or accommodation. Avoidance would result in displacement of animals from an area larger than the actual disturbance area. The total extent of habitat loss as a result of the wildlife avoidance response is impossible to predict since the degree of this response varies from species to species and can even vary between individuals of the same species. Also, after initial avoidance of human activity and noise-producing areas, certain wildlife species may acclimate to the activity and begin to reoccupy areas formerly avoided. For example, during the initial development phases, it is likely that big game (i.e., pronghorn and deer) would be displaced from a larger area than the actual disturbance sites due to the avoidance response. However, these big game species have demonstrated the ability to acclimate to a variety of activities as long as human harassment levels do not increase substantially (Ward 1976). Therefore, it is possible that the extent of displacement would approximate the actual disturbance area after the first few years of mine operation (Ward 1976). In addition to avoidance response, increased human presence intensifies the potential for wildlife/human interactions ranging from harassment of wildlife to poaching and legal harvest.

Three factors would combine to help minimize the potential effects related to increased human presence in the study area. First, the Proposed Action is an expansion of an existing mine site where human activity associated with processing operations continues to date. Second, the location of the mine site is in close proximity to a number of other mining operations in the project vicinity (e.g., Newmont's Blue Star/Genesis, Deep Star, Lantern, Section 36, North Lantern, Leeville, and the Bootstrap Mine) that currently experience relatively high human presence and noise levels. Third, BGMI has developed an environmental awareness course for employee orientation that was implemented in association with the existing mine and would continue to be implemented under the Proposed Action. Under the Proposed Action, this program would be required for all construction and operations personnel to inform them of applicable federal and state laws, caution against animal harassment, and develop an awareness of, and sensitivity to, wildlife issues and concerns specific to the mine site.

The number of personnel traveling to and from the mine site would not change from existing levels, and the potential for increased wildlife mortalities from mine-related vehicles along the mine access roads is expected to remain negligible, due to mine-regulated speed limits on mine roads, and bus transportation to and from the mine site for mine employees.

Water Quality and Quantity

Wildlife populations within the study area could be affected by exposure to mine-related process solutions, which could contain potentially toxic levels of cyanide. Potential sources for wildlife exposure to these solutions would include the proposed Goldstrike No. 3 Tailings Facility. The proposed tailings facility would be designed and constructed as a zero discharge facility to minimize the potential release of process solutions outside of the protected containment area.

To minimize impacts to wildlife from exposure to adverse cyanide concentrations at the tailings impoundment, BGMI has committed to maintaining WAD cyanide concentrations at non-lethal levels, less than 50 ppm (Donato et al. 2007) and generally less than 20 ppm. Cyanide concentrations are in compliance with the Industrial Artificial Pond permit issued from NDOW. Based on BGMI's committed environmental protection measures, potential impacts to wildlife resources from cyanide ingestion would be low.

Pit Lake Ecological Risk Assessment

Based on guidance in BLM IM NV-2004-031, Ecological Risk Assessment Guidelines for Open Pit Mine Lakes in Nevada (BLM 2004), "ERAs should normally be used for additional analysis when the predicted pit water chemistry identifies a potential problem with the future pit lake." The BLM is directed to consider the applicable water quality standards in determining the need for an ecological risk assessment (ERA).

BGMI chose to conduct a screening-level ERA for the project to evaluate potential adverse effects to wildlife and aquatic life that could be exposed to the post-mining Betze Pit Lake. Standardized USEPA procedures were followed using USEPA and Nevada BLM guidance (Hunter 2008), applied to the pit conditions expected based on the Betze Pit Lake Water Quality Prediction Report (Schafer 2007) data.

The screening-level ERA therefore prospectively quantified anticipated risk for chemical exposures of ecological receptors selected on the basis of the ecological site conceptual model. The surface water chemical concentrations are those predicted to be present in the Betze Pit Lake from the Proposed Action when dewatering ceases as detailed in Schafer (2007). The screening level ERA compared standard ecological screening benchmarks against predicted concentrations in pit lake water at Year 50 in order to identify the ecological constituents of potential concern.

It should be noted that the screening level ERA discussed here (Hunter 2008) only considers, prospectively, the Proposed Action. It does not consider the ecological risk associated with the No Action Alternative. The Betze Project SEIS (BLM 2000a) conducted a screening level evaluation of pit water (see Section 3.4.2.4 of the Draft SEIS), comparing predicted water quality against standard screening benchmarks for wildlife (Sample et al. 1996). That evaluation did not consider potential risk to aquatic life.

The evaluation in the Betze Project SEIS (BLM 2000a) concluded that the pit lake may over time develop an aquatic community of aquatic plants and aquatic invertebrates. However, the inaccessibility of the pit water limits its use by terrestrial wildlife, and the limited amount of aquatic resources likely to develop limits its use as a substantial food source for avian and bat wildlife. The evaluation concluded that the anticipated concentrations of metals would not result in reported ecological risk to the three selected wildlife species (rough-winged swallow, red-tailed hawk, and little brown bat).

An ERA is directed towards evaluating if there is potential for ecological risk (i.e., adverse effects to biota from exposure to the stressor). It is by nature conservative, utilizing conservative screening level assumptions and benchmarks in order to allow elimination of those exposures which have no potential for adverse effects. Reporting of a potential risk does not necessarily imply that an adverse effect is actually present or likely to occur, but triggers additional evaluation of site-specific factors to further consider the potential for adverse risks.

The prospective screening level risk assessment conducted by Hunter (2008) sets out a conceptual site model for the pit lake where the pit lake develops a littoral zone, and could be attractive to a variety of birds and mammals, and possibly livestock. Even fish are considered possible, if fish are deliberately introduced, or immigrate spontaneously from the Rodeo Creek Diversion into the pit at the end of mining or by occasional bird transport. The risk assessment considered various species that could conceivably use resources in the pit lake, including birds (cliff swallow, bald eagle, mallard duck, killdeer, and western grebe); mammals (mule deer, little brown bat, and livestock); and fish (introduced bluegill sunfish and bass were noted). arsenic, selenium, cadmium, and nickel were identified for further quantitative risk analysis in the screening level ERA when compared against standard screening benchmarks.

Betze Pit Lake Water conditions from Year 50 (Schafer 2007) were chosen for the ERA because rapid infilling, erosion, and wall sloughing during the years prior to Year 50 are expected to create an unstable pit lake, thus prohibiting substantial development of biological activity (Hunter 2008). The pit lake water constituent of potential concern (COPC) concentrations are expected to be higher without the Rodeo Creek Diversion into the pit after closure (Shafer 2007). These higher COPC concentrations were used for the ERA in order to predict the impacts to wildlife using the most conservative model.

To assess the potential exposure of the selected species, a conservative deterministic dose model (USEPA 1993) was applied to the birds and mammals, applying conservative biota-sediment bioaccumulation factors and bioaccumulation factors to account for biotransfer of COPCs via food sources to the wildlife species, in addition to direct contact and ingestion of sediment and surface water. This approach yields conservative estimates, as it is assumed that a large portion (or all) of the resources the population needs are derived from the pit lake, an unlikely scenario in view of the limited habitat expected to develop and the general inaccessibility of the area.

In an additional step, the effects analysis, potentially toxic doses, or toxicity reference values (TRVs), were derived for the wildlife species to compare to the doses calculated in the exposure analysis. This evaluation, based on literature data, uses toxicity data from the species of concern or taxonomically similar species to derive the threshold for "safe" doses to calculate. Upper bound and lower bound TRVs were derived, representing the highest dose that will not result in an adverse effect and the lowest dose that may result in an adverse effect, per standard risk assessment practice.

For the fish evaluation, development of TRVs as noted above were not used, and toxicity tests were instead conducted using fathead minnows (*Pimephales promelas*) exposed to water conditions simulating the anticipated concentrations in the pit lake at Year 50 (Hunter 2008; Schafer 2007). This species is commonly used as a surrogate for native fish species, as standard, accepted protocols exist, and its universal use allow comparative analysis. However, the use of the fathead minnow may not necessarily be representative of all fish species, and the evaluation needs to consider its representativeness to local conditions on a case-by-case basis.

The screening level risk assessment concluded that ecological risk to the wildlife receptors is not likely from pit water exposure. The potential risk is expressed as a Hazard Quotient (HQ) equal to the exposure dose divided by the TRV, where a HQ<1 indicates that there is no potential for adverse effects, while a HQ>1 indicates such risk cannot be excluded. Even under the conservative input assumptions, there was no potential for adverse effects ("risk") for any of the wildlife or livestock species under lower or upper bound estimate conditions, except for the lower bound estimates for a few cases (the swallow and the bat). In both of these cases the conservative assumptions required that the level of exposure be much higher than realistically expected (for example, the swallow is assumed to gather all the mud needed for its nest from the pit lake, and the bat consumes insects that all emerged from larval stages spent in the pit lake). Considering that such assumptions are unrealistically conservative, the risk assessment concluded that the Betze Pit Lake is not likely to result in adverse effects to wildlife or livestock under anticipated future conditions at Year 50.

While a fish community is not anticipated for the pit lake under the Proposed Action or alternatives, it is possible that fish may end up present in the pit lake either through spontaneous immigration of fish possibly present in local watercourses (e.g., dace, minnow, or chub species), or the deliberate stocking of fish (e.g., sunfish, bass, or even trout). Introduction of fish to the pit lake is not planned by BGMI and any such introduction would need to consider the potential for success in view of the physical and chemical conditions in the pit lake.

The ERA considered potential risk to any fish, and concluded, based on literature toxicity data, that exposure to anticipated concentrations of arsenic in the pit lake, particularly in consideration of the elevated sulfate levels (>1,000 mg/L) that risk to fish from exposure to arsenic concentrations was unlikely. High sulfate lowers the toxicity of arsenic. Selenium has highly site-specific toxicity characteristics. Based on comparative data from other pit lake data in Nevada it appears that bioaccumulation of selenium would be lower than the default

assumed in the National Ambient Water Quality Criteria calculations, and adverse effects from selenium would not be anticipated to fish or to piscivorous wildlife.

Cadmium and nickel concentrations are anticipated to be elevated to levels above screening levels, and ecological risk to fish was evaluated with additional testing. Laboratory toxicity tests were conducted on the fathead minnow (*Pimephales promelas*) to evaluate potential toxicity from nickel and cadmium. Results show that acute toxicity is not expected from nickel or cadmium concentrations up to at least 4 mg/L nickel and 0.09 mg/L cadmium. Survival of fish populations at the anticipated concentrations would not be adversely impacted.

The fathead minnow is considered relatively tolerant of nickel and cadmium relative to more sensitive species such as trout, and possibly bass. However, the fathead minnow is likely a good surrogate for the taxonomically and ecologically related fish species in the area, which permits the conclusion that adverse ecological effects to spontaneously immigrating fish is not likely.

A further consideration is that the anticipated hardness of the pit water is expected to be elevated (1,270 mg/L as $CaCO_3$). While in general metal toxicity decreases with increasing hardness, the anticipated levels are considerably above the upper bound of hardness values that are considered in standard toxicity screening. It is true that the elevated hardness may affect the applicability of hardness data. However, the use of empirical toxicity tests showed that even the most sensitive parameters, nickel and cadmium, did not result in toxicity under simulated ambient conditions, reinforcing the conclusion of no anticipated toxic effects.

Hazardous Materials Spill

The probability of a transportation-related spill of process chemicals along the transportation route is discussed in Section 3.14, Hazardous Materials and Solid Waste. The potential for wildlife exposure to toxic chemicals as a result of a transportation-related spill would be greatest if an accident were to occur near aquatic habitats. Spills in dryland habitat would pose only minimal risk to most wildlife species since these spills would be adjacent to highways and could be rapidly contained and cleaned up.

In general, the materials of greatest concern would be sodium cyanide, sodium hydroxide, and diesel fuel. The effects of a sodium cyanide release would be highly variable and would depend on the quantity released, the location of the release (e.g., dry upland area, wet meadow area, or flowing stream area), the species exposed, and the chemical conditions at the release location. The most likely effect of a potential release of sodium cyanide would be the poisoning of terrestrial or aquatic species. Animal species that drink contaminated water could suffer severe effects or death depending on the concentration of cyanide and the volume of the water consumed. Sodium cyanide solution decomposes rapidly when in contact with the atmosphere into poisonous and flammable hydrogen cyanide gas. Animal species that breathe this gas could suffer severe effects or death depending on the concentration of cyanide gas and the duration of exposure. Environmental effects of a cyanide spill or leak would be limited in extent and time of contamination, due to the rapid degradation of cyanide into benign elements when exposed to direct sunlight or oxygen.

Sodium hydroxide spilled onto the ground or into a water body has the potential to cause short-term damage to localized terrestrial and aquatic habitats. A sodium hydroxide release into a stream or other water body has the potential to raise the pH of the water and temporarily reduce populations of aquatic invertebrates, amphibians, and fish.

A diesel spill has the potential to contaminate soil, surface water, and groundwater in addition to harming aquatic life and vegetation. Although unlikely, such a spill also could ignite from the accident and cause a range fire. Since cleanup actions would take place immediately, diesel contamination has a low potential to result in long-term impacts to soil, surface water, and possibly groundwater.

The risk of wildlife exposure associated with accidental spills into aquatic habitats would be highly unlikely for several reasons. The probability of an accident and the resulting release of process chemicals would be low as discussed in Section 3.14, Hazardous Materials and Solid Waste, and areas of aquatic habitat adjacent to the

proposed transportation route are limited. Hazardous chemicals would be transported via U.S. Department of Transportation (USDOT)-certified containers and transporters, and transportation of sodium cyanide and other chemical reagents would be in accordance with all applicable rules and regulations. Goldstrike Mine was certified May 17, 2007 by International Cyanide Management Code (ICMC) for the mining industry (ICMC 2008). In the event of a spill, a carrier would be required to implement appropriate emergency response measures as stipulated by state and federal regulations. In addition, as discussed in Section 3.14, Hazardous Materials and Solid Waste, BGMI would implement the existing Environmental Incident Response Manual that establishes procedures for responding to accidental spills or releases of hazardous materials to minimize environmental risks.

Special Status Species

The Proposed Action would result in the long-term reduction of approximately 943 acres of native vegetation, including approximately 867 acres of sagebrush shrubland habitat. Woody species such as sagebrush would require up to 25 years to reach maturity. The disturbance associated with the proposed project would be reclaimed following completion of mining activities.

Impacts to special status species from mine-related surface disturbance would include the temporary (short-term and long-term) and permanent reduction or loss of habitat. This impact would result from construction and operation of the proposed project facilities that include expansion of the Betze Pit, and development of the Clydesdale Waste Rock Facility and haul road and Goldstrike No. 3 Tailings Facility. Habitat loss or alteration would result in direct losses of smaller, less mobile species of wildlife, such as small mammals and reptiles, and the displacement of more mobile species into adjacent habitats. In areas where habitats are at, or near, carrying capacity, animal displacement could result in some unquantifiable reductions in local wildlife populations. Mine-related surface disturbance also would result in an incremental increase in habitat fragmentation at the mine site until vegetation has been re-established. It is anticipated that the potential mine-related displacement and habitat fragmentation effects would be highest for special status species that may use the Bell Creek corridor.

Mammals

Bats

Of the 14 bat species that could occur in the study area, 9 species (western red bat, pallid bat, Townsend's big-eared bat, big brown bat, small-footed myotis, long-eared myotis, long-legged myotis, western pipistrelle bat, and Brazilian free-tailed bat) have been documented within the project region (BLM 2000a; Bradley et al. 2006; Lamp 2007c). Potentially suitable habitat for the remaining five species (hoary bat, little brown myotis, California myotis, and Yuma myotis) exists within the study area. Implementation of the Proposed Action could result in direct and indirect impacts to local bat species and their habitat. Direct impacts would include the long-term disturbance of foraging habitat, including approximately 867 acres of sagebrush shrublands habitat. Impacts also would result in the permanent loss of approximately 101 acres of potentially suitable habitat from the development of the proposed facilities.

Preble's Shrew

Implementation of the Proposed Action would result in the long-term reduction of approximately 943 acres, and permanent loss of approximately 101 acres of potentially suitable habitat for this species. This impact would be considered low, considering the large amount of suitable habitat located within the study area. However, project construction likely would result in the direct mortality of individual shrews, if present. The loss of individual Preble's shrews would not result in population-level effects.

Pygmy Rabbit

Implementation of the Proposed Action would result in the long-term reduction of approximately 867 acres, and permanent loss of approximately 101 acres of potentially suitable sagebrush habitat (sagebrush-

dominated habitats) for this species (see **Table 3.7-3**). This impact would be considered low, considering the small amount preferred habitat (i.e., big sagebrush) located within the study area. However, project construction likely would result in the direct mortalities of individual rabbits, if present. The loss of individual pygmy rabbits (a game species in Nevada) would not result in population-level effects.

Fletcher Dark Kangaroo Mouse

Implementation of the Proposed Action would result in the long-term reduction of approximately 943 acres, and permanent loss of approximately 101 acres of potentially suitable habitat for this species. This impact would be considered low, considering the large amount of suitable habitat located within the study area. However, project construction likely would result in the direct mortalities of individual mice, if present. The loss of individual Fletcher dark kangaroo mice would not result in population-level effects.

Birds

Based on implementation of applicant-committed environmental protection measures, no adverse effects to sensitive raptor species have been identified in association with rerouting power distribution lines around the proposed pit layback areas, and the potential for impacts to sensitive bird species related to exposure to process solutions would be considered low. Other potential species-specific impacts are discussed below.

Bald Eagle

No bald eagle nest sites occur within the project boundary. Occurrence by this species would be limited to migrating and wintering individuals. Impacts would include the long-term reduction of approximately 943 acres of potential foraging habitat, until reclamation has been completed and vegetation has been re-established, and the permanent loss of approximately 101 acres of potential foraging habitat associated with development of the proposed facilities. Indirect impacts associated with mine-related noise and human presence currently occurs at the site and would continue under the proposed project. Based on implementation of BGMI's committed environmental protection measures, the lack of existing nest sites within the project boundary, and the existing level of mining activity at the site, potential impacts to this species as a result of the Proposed Action would be considered low.

Swainson's Hawk

No Swainson's hawk nests have been identified in the study area. In addition, no suitable nesting habitat occurs within the project boundary. Direct impacts would include the long-term reduction of approximately 943 acres of potential foraging habitat, until reclamation has been completed and vegetation has been re-established, and the permanent loss of approximately 101 acres of potential foraging habitat associated with development of the proposed facilities. However, this impact would be considered negligible based on the overall availability of suitable foraging habitat in the vicinity of the study area. Indirect impacts would continue to result from mine-related noise and human presence. Based on implementation of BGMI's committed environmental protection measures, the lack of existing nest sites within the project vicinity, and the existing level of mining activity at the site, potential impacts to this species as a result of the Proposed Action would be considered low.

Ferruginous Hawk

As discussed above, no ferruginous hawk nests have been identified in the vicinity of the study area. In addition, no suitable nesting habitat occurs within the project boundary. Direct impacts would include the long-term reduction of approximately 943 acres of potential foraging habitat, until reclamation has been completed and vegetation has been re-established, and the permanent loss of approximately 101 acres of potential foraging habitat associated with development of the proposed facilities. However, this impact would be considered negligible based on the overall availability of suitable foraging habitat in the vicinity of the study area. Indirect impacts would continue to result from mine-related noise and human presence. Based on implementation of BGMI's committed environmental protection measures, the lack of existing nest sites within

the project vicinity, and the existing level of mining activity at the site, potential impacts to this species as a result of the Proposed Action would be considered low.

Golden Eagle

No golden eagle nest sites occur within the project boundary. In addition, no suitable nesting habitat (e.g., exposed rocky outcrops) occurs within the project boundary. Direct impacts would include the long-term reduction of approximately 943 acres of potential foraging habitat, until reclamation has been completed and vegetation has been re-established, and the permanent loss of approximately 101 acres of potential foraging habitat associated with development of the proposed facilities. Indirect impacts associated with mine-related noise and human presence currently occurs at the site and would continue under the proposed project. Based on implementation of BGMI's committed environmental protection measures, the lack of existing nest sites within the project boundary, and the existing level of mining activity at the site, potential impacts to this species as a result of the Proposed Action would be considered low.

Peregrine Falcon

No peregrine falcon nests have been identified in the vicinity of the study area. However, no impacts to breeding birds as a result of proposed mine-related activities would be anticipated based on the lack of potentially suitable breeding habitat (e.g., tall cliffs) in the proposed disturbance areas. Direct impacts to this species would result from the long-term reduction of approximately 943 acres of potential foraging habitat and the permanent loss of approximately 101 acres of potential foraging habitat in association with the development of the proposed facilities. Indirect impacts would continue to result from mine-related noise and human presence. Based on the implementation of BGMI's committed environmental protection measures, the lack of existing nest sites within the project boundary, and the existing level of mining activity at the site, potential impacts to this species as a result of the proposed project would be considered low.

Prairie Falcon

No prairie falcon nest sites have been documented within the project vicinity. In addition, no suitable nesting habitat (e.g., cliffs) occurs within the project boundary. Direct impacts to migrating and foraging falcons would include the long-term reduction of approximately 943 acres of potential foraging habitat, until reclamation has been completed and vegetation has been re-established, and the permanent loss of approximately 101 acres of habitat associated with development of the proposed facilities. Indirect impacts would continue to result from mine-related noise and human presence. Based on the implementation of BGMI's committed environmental protection measures, the lack of existing nest sites within the project boundary, and the existing level of mining activity at the site, potential impacts to this species as a result of the Proposed Action would be considered low.

Greater Sage-grouse

No active greater sage-grouse lek sites have been identified within the project boundary. As discussed in Section 3.8.1.5, the nearest active lek site occurs approximately 5.5 miles north of the project boundary. As a result no impacts to breeding greater sage-grouse would be anticipated from project activities. Although greater sage-grouse could nest in upland habitats within the project boundary, it is anticipated that brooding activity would be low, due to the limited availability of surface water and riparian vegetation in the study area. Potential direct impacts would include the incremental long-term reduction of approximately 943 acres of nesting habitat, summer range, and winter range. Direct impacts to this species would include the long-term reduction of approximately 867 acres of sagebrush shrublands habitat and the permanent loss of approximately 101 acres of sagebrush shrublands habitat in association with the development of the proposed facilities. Indirect impacts would continue to result from mine-related noise and human presence. This impact would be considered negligible based on the overall availability of suitable habitat in the vicinity of the project. Refer to Section 3.1 for a list of conservation projects currently implemented in the region.

Burrowing Owl

Although no burrowing owl nest sites have been documented within the project boundary, sagebrush shrubland and grassland vegetation that would be disturbed as a result of the Proposed Action would be suitable habitat for foraging birds within the study area. However, based on BGMI's committed environmental protection measures, including nesting raptor surveys and implementation of mitigation measures, as applicable, impacts to breeding birds would be minimized. Direct impacts to this species would include the short-term reduction of approximately 943 acres of potential breeding and foraging habitat, until reclamation has been completed and vegetation has been re-established, and the permanent loss of approximately 101 acres of habitat associated with development of the proposed facilities. Indirect impacts would continue to result from mine-related noise and human presence. Based on implementation of BGMI's committed environmental protection measures and the existing level of mining activity at the site, potential impacts to this species as a result of the Proposed Action would be considered low.

Long-eared Owl

This species has not been documented breeding within the study area, and no suitable breeding habitat is present within the study area. Therefore, impacts to breeding birds as a result of proposed mine-related activities would not be anticipated. Direct impacts to this species would result from the long-term reduction of approximately 943 acres of potential foraging habitat and the permanent loss of approximately 101 acres of potential foraging habitat in association with the development of the proposed facilities. These impacts would be considered negligible based on the overall availability of suitable habitat in the vicinity of the project. Indirect impacts would continue to result from mine-related noise and human presence. Based on the implementation of BGMI's committed environmental protection measures, the overall availability of suitable habitat in the vicinity of the project, and the existing level of mining activity at the site, potential impacts to this species as a result of the Proposed Action would be considered low.

Short-eared Owl

This species has not been documented breeding within the study area, although suitable nesting habitat is present. Impacts to breeding birds as a result of proposed mine-related activities would be anticipated based on potentially suitable breeding habitat (e.g., open shrublands) in the proposed disturbance areas. Direct impacts to this species would result from the long-term reduction of approximately 943 acres of potential foraging habitat and the permanent loss of approximately 101 acres of potential foraging habitat in association with the development of the proposed facilities. These impacts would be considered negligible based on the overall availability of suitable habitat in the vicinity of the project. Indirect impacts would continue to result from mine-related noise and human presence. Based on the implementation of BGMI's committed environmental protection measures, the overall availability of suitable habitat in the vicinity of the project, and the existing level of mining activity at the site, potential impacts to this species as a result of the Proposed Action would be considered low.

Loggerhead Shrike

Based on the presence of potentially suitable breeding habitat, direct impacts to breeding pairs as a result of proposed mine-related activities and the applicable environmental protection measures to minimize these impacts would parallel those described above for the short-eared owl. Direct impacts to this species would include the long-term reduction of approximately 943 acres of potential breeding and foraging habitat, until reclamation has been completed and vegetation has re-established, and the permanent loss of approximately 101 acres of breeding and foraging habitat in association with the development of the proposed facilities. Indirect impacts would continue to result from mine-related noise and human presence. These impacts would be considered negligible based on implementation of BGMI's committed environmental protection measures, the overall availability of suitable habitat in the vicinity of the project, and the existing level of mining activity at the site.

Yellow-breasted Chat

Based on the presence of potentially suitable breeding habitat in the project region, direct impacts to breeding pairs as a result of proposed mine-related activities and the applicable environmental protection measures to minimize these impacts would parallel those described above for the short-eared owl. These impacts would be considered negligible based on implementation of BGMI's committed environmental protection measures, the overall availability of suitable habitat in the vicinity of the project, and the existing level of mining activity at the site.

Vesper Sparrow

Based on the presence of potentially suitable breeding habitat, direct impacts to breeding pairs as a result of proposed mine-related activities and the applicable environmental protection measures to minimize these impacts would parallel those described above for the short-eared owl. Direct impacts to this species would include the long-term reduction of approximately 943 acres of potential breeding and foraging habitat, until reclamation has been completed and vegetation has re-established, and the permanent loss of approximately 101 acres of breeding and foraging habitat in association with the development of the proposed facilities. Indirect impacts would continue to result from mine-related noise and human presence. These impacts would be considered negligible based on implementation of BGMI's committed environmental protection measures, the overall availability of suitable habitat in the vicinity of the project, and the existing level of mining activity at the site.

3.8.2.3 Bazza Waste Rock Facility Alternative

Wildlife

Under this Alternative, approximately 565 acres of native wildlife habitat associated with the Clydesdale Waste Rock Facility and associated haul road would not be disturbed or lost, as compared to the Proposed Action. As a result, impacts to the designated big game migration corridor and associated habitat for big game, small game, and nongame (including migratory birds) would not occur. In addition, habitat fragmentation and animal displacement associated with the Clydesdale Waste Rock Facility would not occur. Reclamation of the Bazza Waste Rock Facility would not be completed until 2018, as compared to 2011 for the Proposed Action, and the level of human activity would increase due to increased waste rock haulage until the facility is fully reclaimed. However, currently reclaimed areas of the Bazza Waste Rock Facility would not be disturbed and suitable wildlife habitat would remain on reclaimed portions of the Bazza Waste Rock Facility.

Special Status Species

Impacts to special status species would parallel those described above for wildlife.

3.8.2.4 West Nile Virus

Background

The potential for the proposed project to increase the likelihood of BGMI employees, contractors, and visitors to the Goldstrike Mine to contract West Nile Virus (WNV) was evaluated based on a scoping comment received. WNV is a flavivirus that is spread by mosquitoes, typically *Culex pipiens*, and can infect humans, birds, horses, and some other mammals. **Table 3.8-1** indicates the human WNV incident rates for Eureka and Elko counties, as well as, the State of Nevada. During the past 3 years, there were 164 human cases of WNV reported in Nevada, 25 cases reported in Elko, and 0 cases reported in Eureka counties (Nevada State Health Division [NSHD] 2007). During the past 3 years in the entire U.S., there were 10,673 cases of WNV reported. People become infected with WNV by the bite of a mosquito infected with WNV. The basic transmission cycle is via mosquitoes becoming infected when they feed on infected birds. Infected mosquitoes can then transmit WNV to humans and animals. The virus may cause West Nile Fever—usually a mild disease in humans, characterized by flu-like symptoms. West Nile Fever typically lasts only a few days and does not appear to cause any long-term health effects. More severe diseases resulting from a person being infected with this virus

can be West Nile Encephalitis (an inflammation of the brain), West Nile Meningitis (an inflammation of the membrane around the brain and the spinal cord), or West Nile Meningoencephalitis (inflammation of the brain and the membrane surrounding it).

Table 3.8-1 Human West Nile Cases in Elko County, Eureka County, and Nevada, 2005 to 2007

	2007	2006	2005	To Date (total)
Elko County	2	23	0	25
Eureka County	0	0	0	0
State of Nevada	10	124	30	164

Source: NSHD 2007.

All residents of areas where virus activity has been identified are at risk of getting West Nile encephalitis; however, many people who are infected with WNV experience no symptoms. One in five will develop symptoms, typically headaches and flu-like illness. Only 1 in 150 will develop serious complications. Others may experience mild symptoms, such as low-grade fever, headache and body aches, skin rash or swollen lymph nodes, or nausea within 3 to 15 days. Symptoms may appear suddenly with the onset of severe headache, high fever, stiff neck, and muscle weakness. Among those with severe illness due to WNV, case-fatality rates range from 3 percent to 15 percent and are highest among the elderly. Persons over 50 years of age have the highest risk of severe symptoms.

Although the *Culex pipiens* mosquito is typically a canopy-feeder, it can and does bite humans. The mosquito breeds in shallow, stagnant, or slow moving water, thus these types of habitats at the Goldstrike Mine potentially could contribute to an increased number of mosquitoes, depending upon the location and nature of deposited surface water. Steep banks and moving water would mitigate against this; shallow, stagnant reservoirs would contribute to it.

No Action Alternative

The occurrence of *Culex pipiens* is not prevalent in northeastern Nevada due to the arid climate where evaporation greatly exceeds precipitation and due to lack of suitable habitat. At the Goldstrike Mine, arid conditions and rapid run-off and infiltration of infrequent storm events limits the occurrence of standing water and habitat for *Culex pipiens* to breed. Storm water detention ponds and intermittent drainages within the mine site are typically dry within a few days of precipitation events. The North Block and AA Tailings facilities decant pools would likely provide marginal mosquito breeding habitat due to open water conditions exposed to wind turbulence, and lack of protected areas along the shoreline. The risk of workers or visitors contracting WNV at the Goldstrike Mine is low.

The post-mining pit lake could provide habitat for mosquitoes to breed; however, the habitat is anticipated to be marginal due to the generally steep slopes and open water habitat (Schafer 2007).

Proposed Action

Under the Proposed Action the risk of workers, contractors, or visitors contracting WNV at the mine site would be similar to the No Action Alternative. The decant pool from the Goldstrike No. 3 Tailings facility would be much smaller than the existing North Block Tailings Facility decant pool due to the higher solids-to-water ratio of the tailings slurry. Mosquito breeding habitat also would be marginal for the proposed facility. The post-mining pit lake at equilibrium under the Proposed Action would result in a slightly larger surface area (115 percent) of the No Action Alternative pit lake and a slightly smaller volume (90 percent) (Schafer 2007).

The risk of people contracting WNV at the Goldstrike Mine is low under the Proposed Action. No additional mitigation measures are proposed over current mine practices.

Bazza Waste Rock Facility Alternative

This alternative would result in the same impacts as discussed in the Proposed Action.

3.8.3 Cumulative Impacts

The CESAs for wildlife and special status species encompass a portion of NDOW's WMA 6 as depicted in **Figures 3.8-4** through **3.8-7**. The CESAs were determined by BLM and NDOW and include a contiguous area that provides very important seasonal habitat for mule deer, pronghorn, and greater sage-grouse. Generally, the CESAs extend from the northern end of the Independence Range in the North to the Humboldt River and northern end of the Piñon Range to the South.

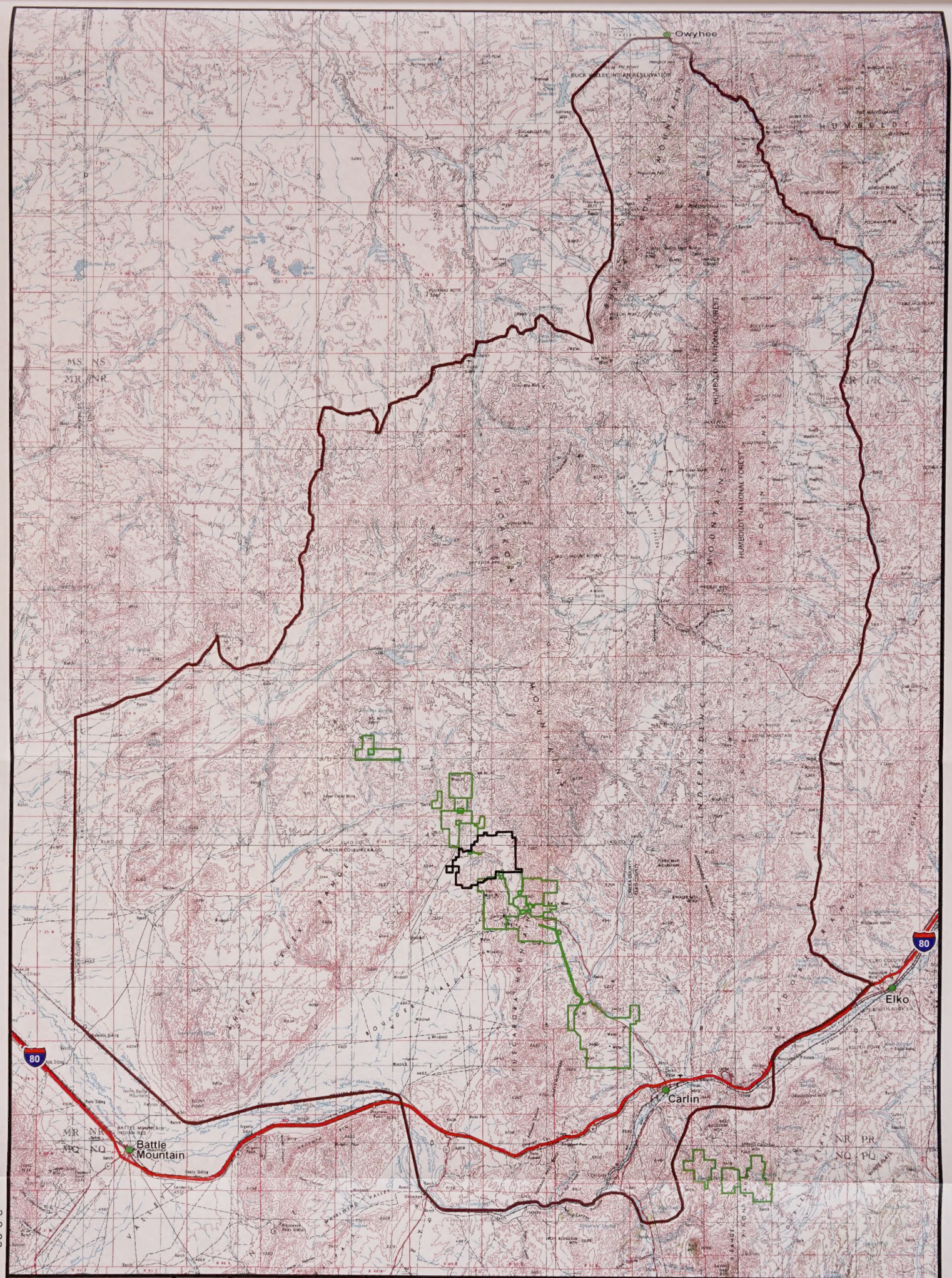
Cumulative effects on wildlife in the CESAs have resulted primarily from wildfires, mineral exploration, mining activities, non-native invasive weeds, livestock grazing, drought, urbanization, and seeding of native range with introduced herbaceous species (BLM 2007b). Other industrial development activities in the area such as a power plant, transmission lines, and roads also contribute to impacts to wildlife (BLM 2007b). Development of reasonably foreseeable mine projects and the TS Power Plant will continue to impact big game in their respective CESA. However, mine areas proposed for development have been the site of human activity including exploration drilling and environmental monitoring programs within or adjacent to existing mine areas (BLM 2007b).

3.8.3.1 No Action Alternative

Terrestrial Wildlife

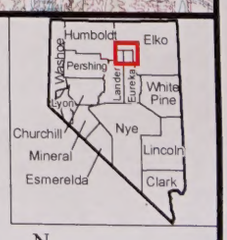
Cumulative impacts to wildlife resources primarily would be directly related to habitat loss, habitat fragmentation, and animal displacement. Big game, especially mule deer, would be most susceptible to these cumulative impacts since encroaching human activities along the foothills of the Tuscarora Range and the Carlin Trend have resulted in animal displacement and habitat fragmentation in areas that are utilized as migration corridors between summer and winter ranges. The population of migrating mule deer has declined from 30,000 to about 8,000 animals due to effects of fire and development on important seasonal ranges (NDOW 2007b). The mild winter of 2006, which caused few mule deer to migrate, also made it difficult to determine accurate populations (Lamp 2007b). Displacement of mule deer and pronghorn from wildfire, mining activities, and other land uses increases demands on adjacent habitats. Most habitats in the immediate area are at carrying capacities and can not support additional animals (Lamp 2007b). Displaced animals would be lost from the population until habitats are rehabilitated, restored, or mitigated, allowing populations to expand into affected areas. Many of the local wildlife populations (e.g., big game, raptors, migratory birds) that occur in the CESAs would continue to occupy their respective ranges and breed successfully, although population numbers may decrease relative to the amount of cumulative habitat loss and disturbance from incremental development.

Within the wildlife, mule deer, and pronghorn CESAs (**Figures 3.8-4** through **3.8-6**), mining has removed wildlife habitat, primarily as a function of fencing and/or land disturbance associated with mining operations. In addition, wildfire has created one of the primary cumulative effects on these species. As shown in **Table 3.8-2**, from 1999 to early August 2007 thousands of acres of wildlife habitat has been impacted by large-scale wildfires (NDOW 2007b). Wildfire has resulted in the temporary to long-term loss of shrubs that provide forage and cover as habitat components, which has caused reductions in mule deer and pronghorn herds throughout their respective CESAs. Effects of wildfires to terrestrial wildlife species include loss of habitat (forage and cover) which can lead to die-offs of mule deer and pronghorn as well as other species. The loss of canopy cover and forb and grass diversity is prevalent across the burned areas and the recovery of these plant communities will vary in terms of time and cover. In many areas, native shrub communities have been replaced by cheatgrass-dominated grasslands (BLM 2007b). A breakdown of disturbance by mining operations and wildfire is presented in **Table 3.8-2**.



LEGEND

- Wildlife Cumulative Effects Study Area
- Goldstrike Mine Operations Boundary
- Mine Plan Boundary



N

0 5 10 Miles

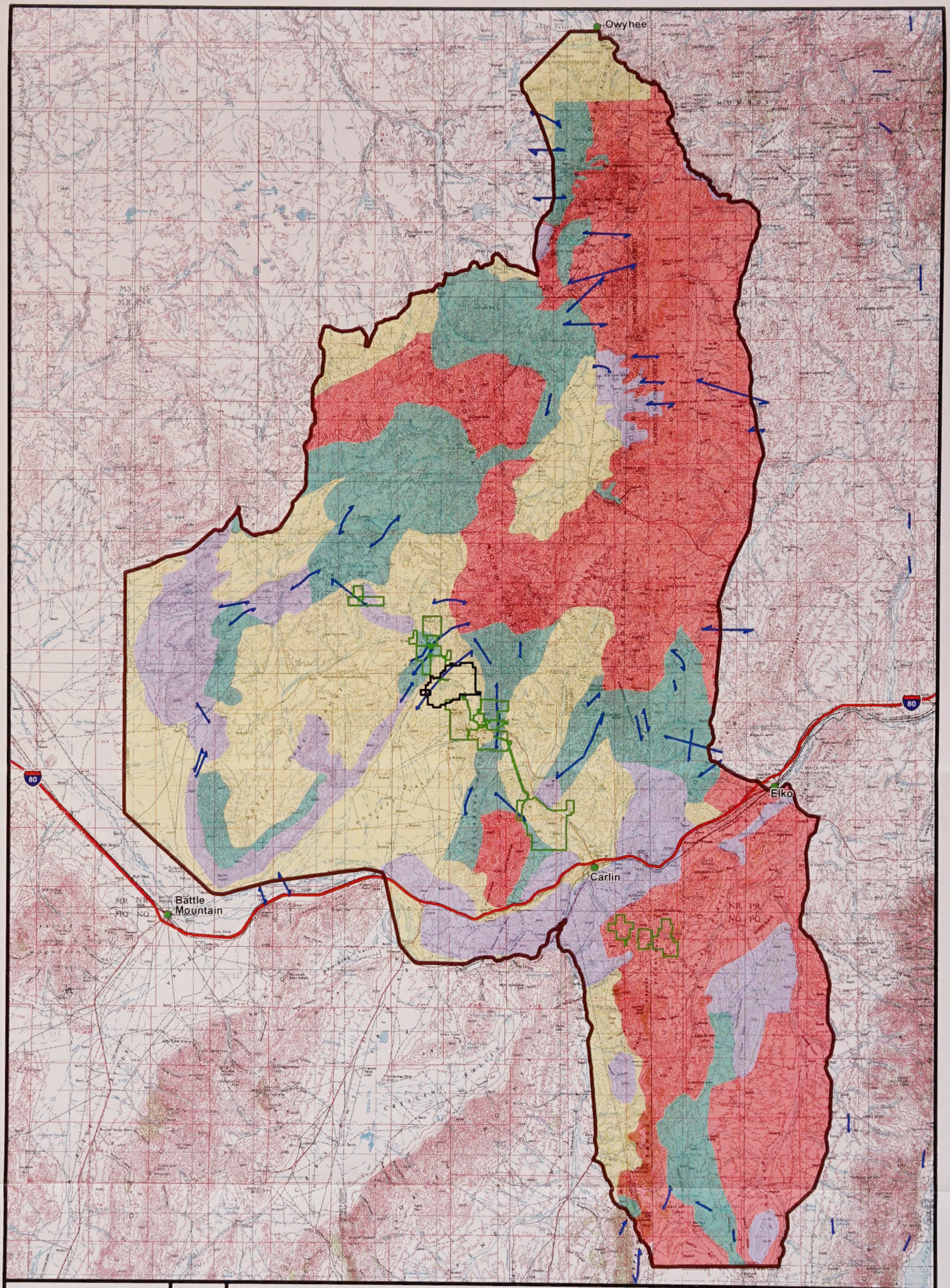
Source: BLM 2007b,c.

Betze Pit Expansion Project

Figure 3.8-4

Wildlife Cumulative Effects Study Area

06/05/2008



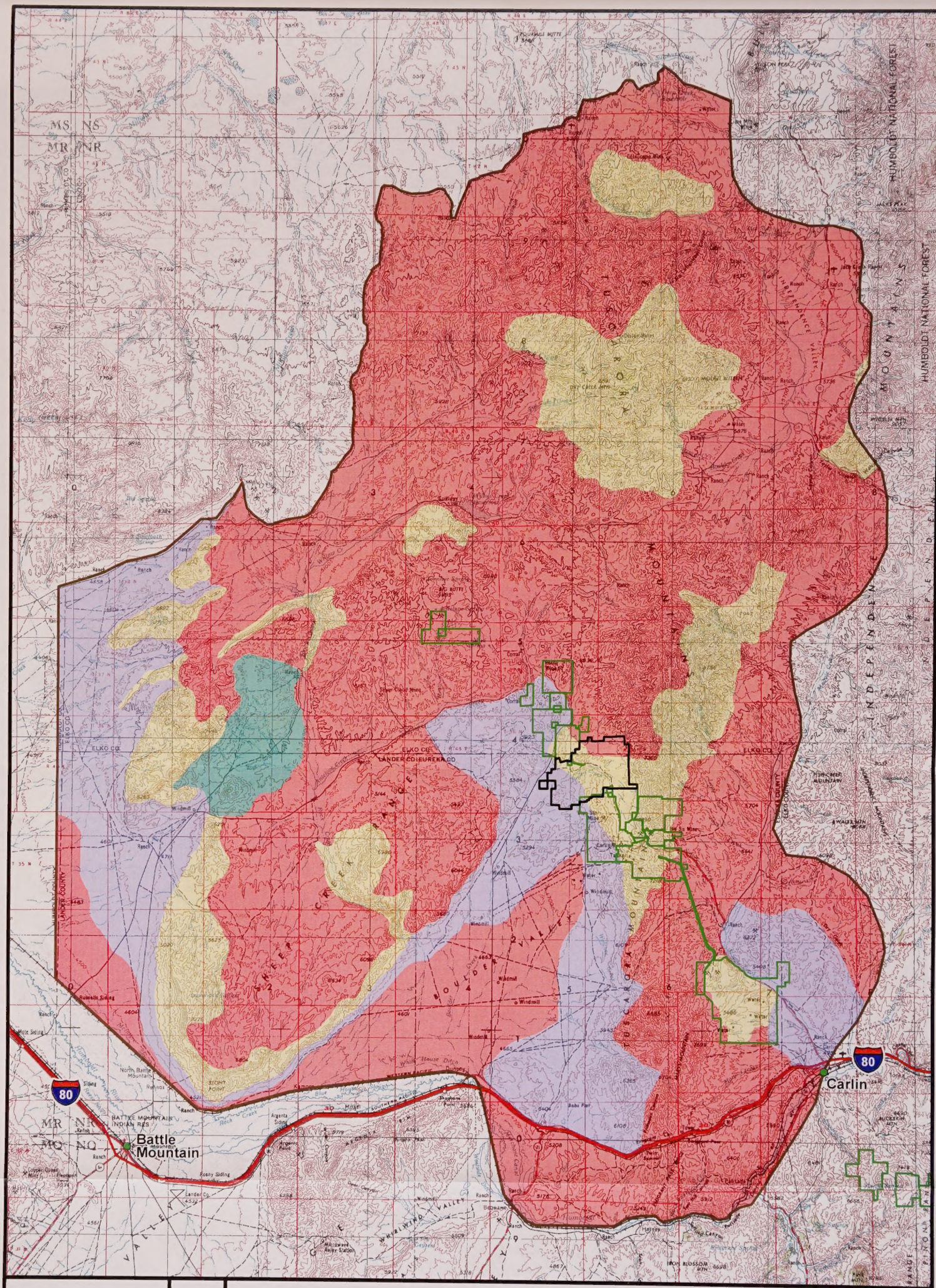
Source: BLM 2007b,c.

Figure 3.8-5
Mule Deer
Cumulative Effects
Study Area

Betze Pit Expansion Project

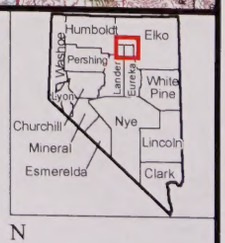
3.8-31

08/05/2008



LEGEND

- Pronghorn Cumulative Effects Study Area
- Goldstrike Mine Operations Boundary
- Mine Plan Boundary
- Crucial Winter Habitat
- Transitional Habitat
- Low Density
- Summer Habitat



N

0 5 10 Miles

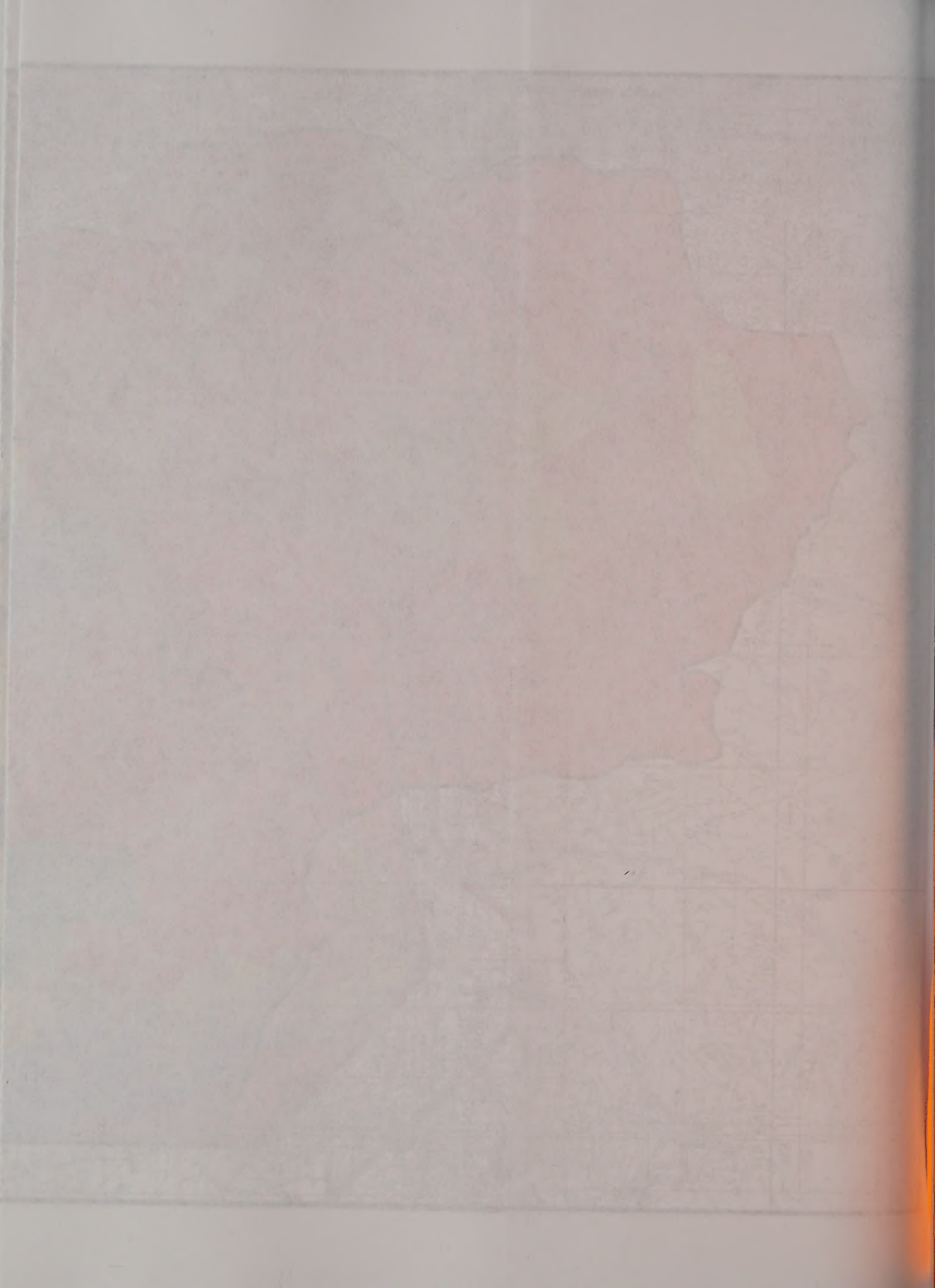
Source: BLM 2008a.

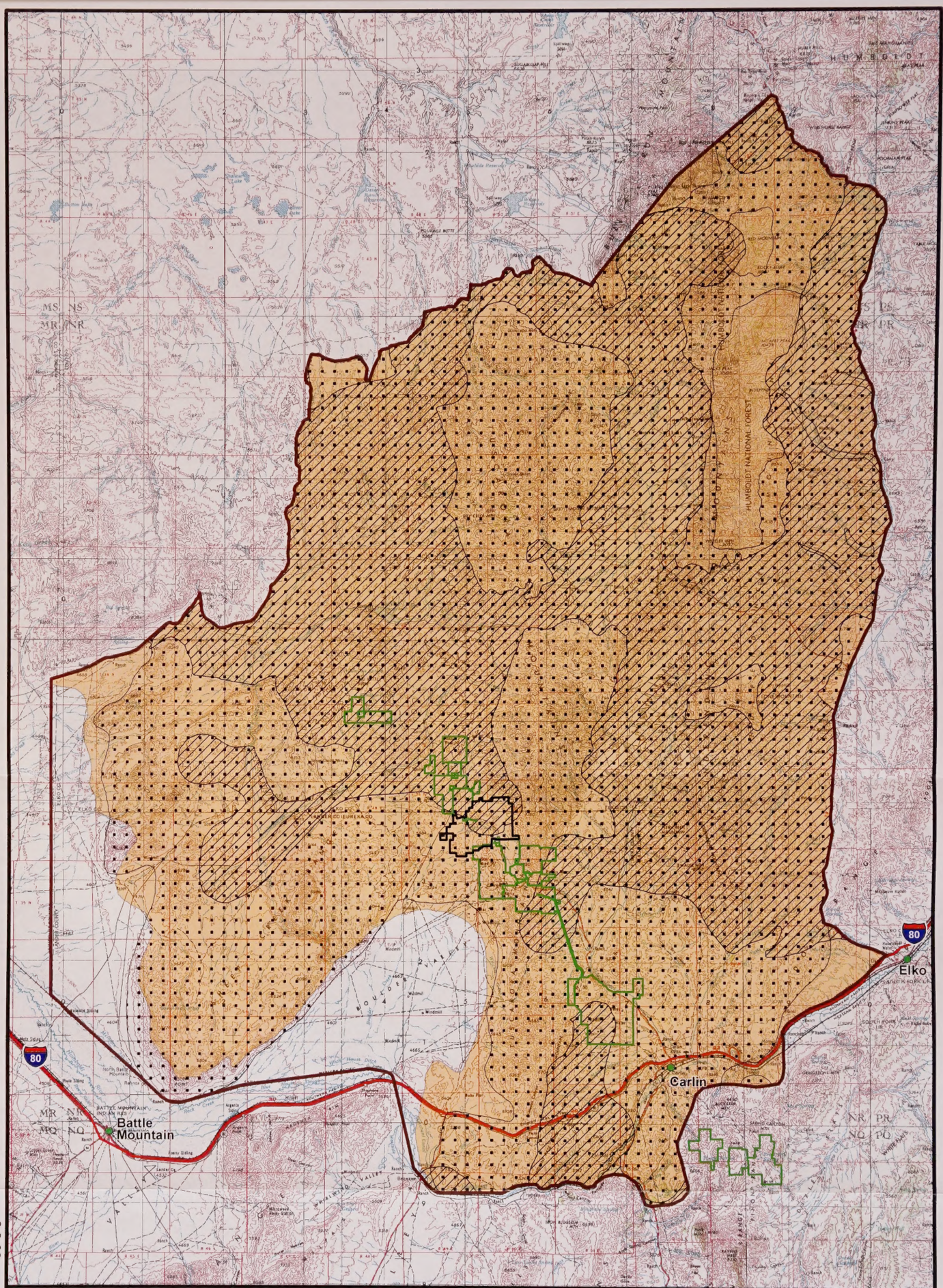
Betze Pit Expansion Project

Figure 3.8-6

Pronghorn Cumulative Effects Study Area

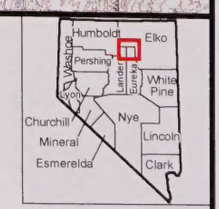
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LEGEND

- Greater Sage-grouse Cumulative Effects Study Area
- Nesting and Early Brood Habitat
- Winter Habitat
- Late Summer Habitat
- Goldstrike Mine Operations Boundary
- Mine Plan Boundary



N

0 5 10 Miles

Source: BLM 2008a; NDOW 2007c.

Figure 3.8-7
Greater Sage-grouse Cumulative Effects Study Area

Betze Pit Expansion Project

06/05/2008

Table 3.8-2 Wildlife, Mule Deer, Pronghorn, and Greater Sage-grouse Habitat Disturbance

CESA	Total Acres of Habitat	Acres Disturbed by Mining Operations (Past, Present, RFFAs)[1]	Acres Disturbed by Fire	% of Total Habitat Acres Disturbed
Wildlife[2]	2,389,957	37,453	958,586	42
Mule Deer	2,119,638	38,700	627,058	31
Pronghorn	1,590,750	37,453	745,821	49
Greater Sage-grouse	2,090,081	37,453	880,537	44

[1]The special status CESA is identical to the wildlife CESA, excluding greater sage-grouse.

[2]See **Table 3.1-1** for breakdown of mining projects.

Source: NDOW 2007c; USGS 2004.

Mine dewatering operations could result in reduction or loss of flow in springs and seeps that support wildlife. Reductions or elimination of flow in springs, seeps, and streams from dewatering could impact wildlife species dependent on these sites (e.g., amphibians and birds) and may affect distribution of other species (e.g., bats, mule deer and pronghorn) that use these sites as part of a larger habitat complex. These impacts are within the area that was disclosed and mitigated for in the 2000/2003 Betze SEIS (BLM 2000a, 2003a) as shown in **Figure 3.3-48** and described in Section 3.3.3.1.

Nesting raptor species also would be susceptible to these cumulative impacts since encroaching human activities along the foothills of the Tuscarora Range and the Carlin Trend have resulted in bird displacement and habitat fragmentation in areas that may be at their relative carrying capacity for these resident species. Many of the local wildlife populations (e.g., small game, migratory birds) that occur in the cumulative effects study area would continue to occupy their respective ranges and breed successfully, although population numbers may decrease relative to the amount of cumulative habitat loss and disturbance from incremental development.

Past and present actions and RFFAs in the wildlife, mule deer, and pronghorn cumulative effects study areas have resulted, or would result, in the direct disturbance of habitat (**Table 3.8-2**). Future underground mining, if it should occur, likely would not result in additional habitat disturbance. A portion of the cumulative disturbance areas have been, or would be, reclaimed or has recovered materially (i.e., wildfire areas). The reclaimed areas, and areas associated with habitat conversion, would be capable of supporting wildlife use; however, species composition and densities would change.

Under currently authorized disturbance, indirect cumulative impacts include increased noise, additional human presence, and the potential for increased vehicle-related mortalities.

Groundwater drawdown associated with existing dewatering operations could result in a long-term reduction in the amount and extent of available surface water (e.g., perennial seeps, springs, streams) and associated riparian habitats for area wildlife within the cumulative 10-foot groundwater drawdown area (**Figure 3.3-26**). The potential cumulative impacts from dewatering have been addressed in the CIA (BLM 2000b) and Betze SEIS (2000a, 2003a) and were mitigated (**Figure 3.3-48** and Section 3.3.4.2).

Special Status Species

The CESA for special-status species is the same as the wildlife CESA (**Figure 3.8-4**) except for greater sage-grouse which is presented in **Figure 3.8-7**. The special status species CESA encompasses habitat that

would have potential to be affected by drawdown from mine dewatering and therefore, potentially impact special status species. **Table 3.8-2** presents the disturbance of special status species habitat by mining operations and wildfire. The CESA for greater sage-grouse encompasses areas that are utilized by greater sage-grouse in relation to past and present actions and RFFAs. **Table 3.8-2** presents the disturbance of greater sage-grouse habitat by mining operations and wildfire. Several thousand acres of cultivated alfalfa in Boulder Valley and the Humboldt River Valley (area north of Battle Mountain) may potentially provide late summer/brood-rearing habitat for greater sage grouse (NDOW 2008a). These areas provide succulent forbs sought by grouse including alfalfa and other annual or perennial forbs. The current extent of potential use of these cultivated areas by greater sage-grouse is unknown since cover provided by sagebrush habitats adjacent to these fields have been impacted by wildfires in many areas over the last 20 to 30 years (NDOW 2008a).

Studies have shown that development can negatively impact sage grouse populations as a result of habitat loss and increased human disturbance (Holloran 2005; Walker et al. 2007). Sage grouse have been observed to abandon lek sites in areas with increased road development (Braun 1986; Holloran 2005; Walker et al. 2007). Compared to hens in undisturbed leks, sage grouse hens that used breeding leks within approximately 2 miles from development moved further away from breeding leks to nesting areas and had lower nest initiation rates (Lyon and Anderson 2003). Furthermore, sage grouse hens that utilized habitats farthest from roads had greater brood survivorship than those hens utilizing habitat near roads (Lyon and Anderson 2003). Connelly et al. (2000) recommends that facilities be located more than 2 miles (3.2 km) from active lek sites under ideal habitat conditions, 3 miles (5 km) when habitat conditions are not ideal, and 11 miles (18 km) when sage grouse populations are migratory. It is assumed that habitat conditions within the project area are not ideal, based on the current level of human disturbance and noise levels, as well as the current activity level (inactive) at the lek site located north of the project area.

Under the current authorized disturbance, potential cumulative impacts to other special status wildlife species would parallel those described above for terrestrial wildlife.

3.8.3.2 Proposed Action

Terrestrial Wildlife

Cumulative impacts to terrestrial wildlife would be similar to those described above under the No Action Alternative cumulative effects, except there would be an additional 943 acres of habitat disturbance associated with the Proposed Action, including the loss of 565 acres of undisturbed sagebrush vegetation in the Little Boulder Valley. NDOW classifies this undisturbed habitat as an important big game migration corridor, especially for mule deer (NDOW 2007b). If the proposed Clydesdale Waste Rock Facility is constructed, there will be no sizeable undisturbed habitat along this portion of the migration corridor (NDOW 2007b). As a result, habitat fragmentation, habitat loss, and animal displacement associated with the construction of the Clydesdale Waste Rock Facility would occur. Indirect impacts such as human presence and noise would incrementally increase and would continue until the facility is fully reclaimed.

Special Status Species

Cumulative impacts to special status species would parallel those described above under the No Action Alternative cumulative impacts except for an additional 943 acres of habitat disturbance associated with the Proposed Action.

3.8.3.3 Bazaa Waste Rock Facility Alternative

Terrestrial Wildlife

Under this alternative, cumulative impacts would be similar to those described above under the No Action Alternative cumulative effects, except that 565 acres of habitat disturbance associated with construction of the Clydesdale Waste Rock Facility and associated haul road would not occur. However, cumulative impacts such

as habitat fragmentation, habitat loss, and animal displacement associated with the Bazaa Waste Rock Facility Alternative would continue to occur as a result of the facility not being fully reclaimed until 2018.

Special Status Species

Cumulative impacts to special status species would parallel those described above for terrestrial wildlife.

3.8.4 Mitigation Measures and Monitoring

All mitigation measures proposed during the course of this review and analysis have been adopted by BGMI and have become operator commitments to reduce impacts to wildlife resources.

Riparian habitat mitigation measures have been provided for with the long-term monitoring and mitigation fund associated with the 1991 Betze EIS and 2003 Betze SEIS and are described in Section 2.2.1.13, Applicant-committed Environmental Protection Measures.

3.8.5 Residual Impacts

Residual impacts to wildlife resources from the proposed project would include the permanent loss of approximately 101 acres of sagebrush habitat associated with the pit expansion. The Bazza Waste Rock Facility Alternative would result in the long-term loss of 301 acres of sagebrush habitat.

3.9 Cultural Resources

3.9.1 Affected Environment

The study area for cultural resources encompasses the project boundary. The CESA encompasses the Carlin Trend extending north to the Bootstrap Mine and south to the Gold Quarry South Operations (**Figure 3.9-1**). The CESA includes those mines and related facilities encompassing the core area of the Carlin Trend. The CESA was determined based on consultation with BLM resource specialists.

3.9.1.1 Regulatory Framework

Federal historic preservation laws provide a legal environment for documentation, evaluation, and protection of cultural resources that may be affected by federal undertakings, or by private undertakings operating under federal license, or on federally managed lands. NEPA states that federal undertakings shall take into consideration impacts to the natural environment with respect to an array of resources, and that alternatives must be considered. The courts have made clear that cultural resources are regarded as part of the natural environment. The National Historic Preservation Act of 1966 (NHPA), as amended, established the Advisory Council on Historic Preservation (ACHP) and the NRHP. The NHPA mandates that federal agencies consider an undertaking's effects on cultural resources that are listed on or eligible for listing on the NRHP, and Section 106 of the NHPA establishes a review process by which these resources are given consideration during the conduct of federal undertakings. Cultural resources that are listed on or eligible for listing on the NRHP are referred to as historic properties.

Regulations in 36 CFR 800 outline the process through which historic preservation legislation under the NHPA is administered; 36 CFR 800.14 allows federal agencies to adopt program alternatives to 36 CFR 800 and to tailor the Section 106 process to better fit agency procedures. The most common program alternative is a PA negotiated among the agency, SHPO, and ACHP.

In June 1991, a PA among the BLM Elko District Office, Nevada SHPO, ACHP, and BGMI was finalized (PA 1991). The PA defines general and specific measures to be undertaken by the BLM, SHPO, and BGMI to ensure that the BLM's objectives and responsibilities regarding the protection of historic properties under the NHPA are fulfilled. Specifically, the PA outlines the steps to be taken to: 1) identify prehistoric and historic sites; 2) evaluate them for eligibility for listing on the NRHP; 3) identify potential adverse effects; 4) develop measures to avoid, reduce, or mitigate adverse effects; and 5) address inadvertent discoveries. Additionally, the PA assigns roles and responsibilities for implementation of the PA, which ensures that all interested parties are given an opportunity to comment on the effects of an undertaking to historic properties and any mitigation for such effects.

3.9.1.2 Eligibility Criteria for Listing Properties on the NRHP

The NRHP, maintained by the National Park Service (NPS) on behalf of the Secretary of the Interior, is the nation's inventory of historic properties. The NPS has established three main standards that a resource must meet to qualify for listing on the NRHP: age, integrity, and significance. To meet the age criteria, a resource generally must be at least 50 years old. To meet the integrity criteria, a resource must "possess integrity of location, design, setting, materials, workmanship, feeling, and association" (36 CFR 60.4). Finally, a resource must be significant according to one or more of the following criteria:

- Criterion A – Be associated with events that have made a significant contribution to the broad patterns of U.S. history; or
- Criterion B – Be associated with the lives of persons significant in U.S. history; or

- Criterion C – Embody the distinctive characteristics of a type, period, or method of construction, or represent the work of a master, or possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction; or
- Criterion D – Have yielded, or may likely yield, information important in prehistory or history.

3.9.1.3 Investigations in the Study Area

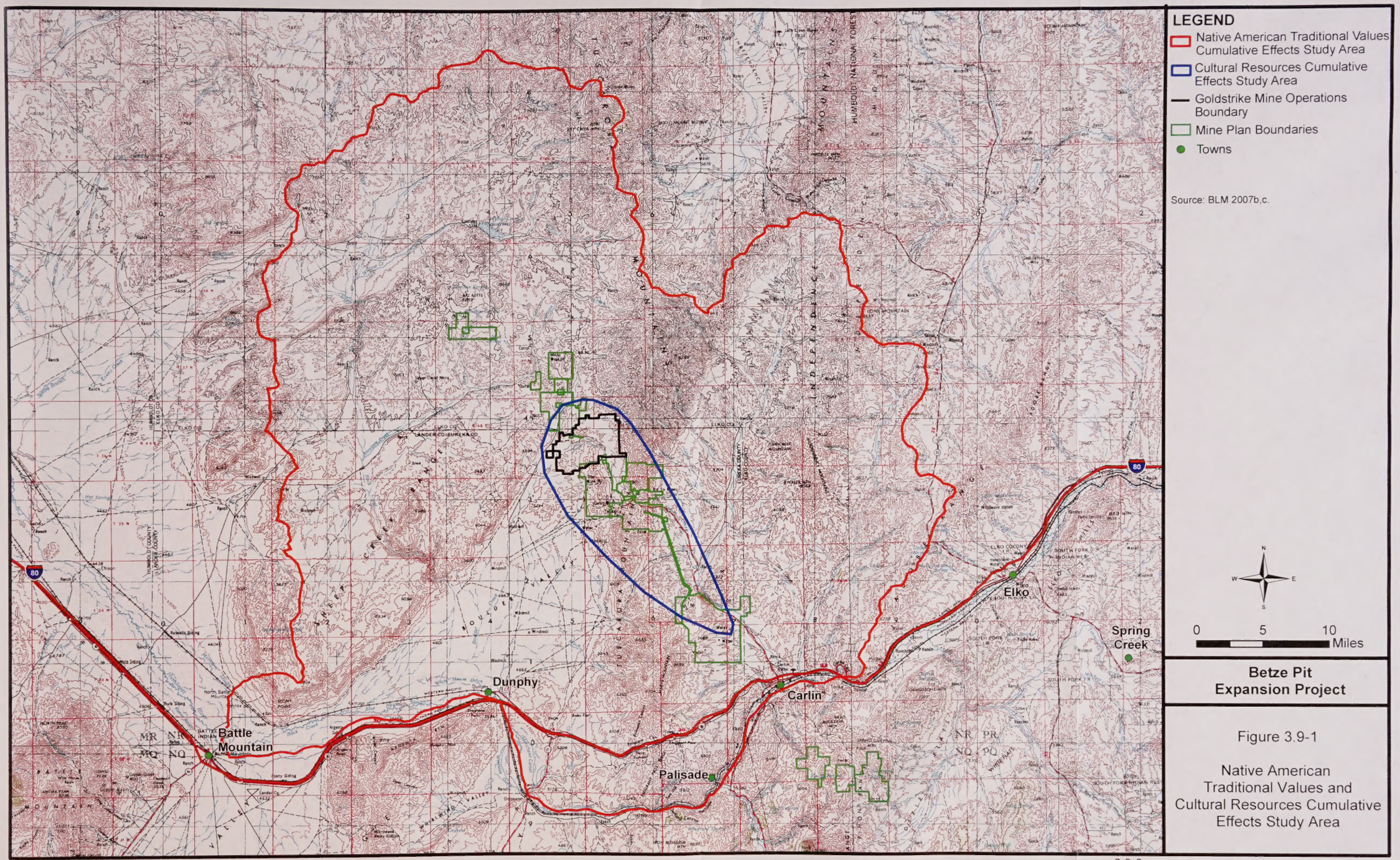
Numerous cultural resource investigations have been conducted in or near the study area. These have included Class I and Class III inventories. Class I inventories are a review of reports containing the results of previously conducted inventories in the study area, as well as library and archival sources for regional prehistory and history. Class III inventories are intensive field surveys in which the archaeologists record and document all sites and isolates encountered on the surface, and evaluate the sites for eligibility to the NRHP. Nearly all of the area within the BGMI property boundary has been inventoried for cultural resources, and the documented sites evaluated for the NRHP. Under the PA, potentially eligible sites or eligible sites were to be avoided until they were threatened with destruction or damage.

The results of the inventories have been documented in survey reports that have been submitted to the BLM and SHPO for review. The reports contain the cultural and historical overview of the area; the location, type, and significance of identified sites; archaeological field methods; artifact analysis; eligibility recommendations for each identified site; and proposed mitigation for historic properties that would be affected by proposed disturbance. Contents of the survey reports, in particular the description and location of recorded sites, are confidential and are not accessible for public review.

As a result of previous cultural resources investigations in the analysis area, five NRHP-eligible prehistoric sites were located within the study area (26EU1533, 26EU1539, 26EU1548, 26EU2064, and 26EU2126). These five sites are eligible for inclusion to the NRHP under Criterion D based on their potential to yield information important in prehistory or history. Subsequently, a data recovery plan was developed by SWCA Environmental Consultants Inc. (SWCA) to mitigate potential adverse effects to the sites (Cannon and Stettler 2007). Data recovery at the five sites was completed in fall 2007. In addition, eight prehistoric sites previously recommended as eligible for the NRHP were located near the study area (26EU1903, 26EU2452, 26EU1549, 26EU1506, 26EU1484, 26EU1486, 26EU1786, and 26EU1528); however, no data recovery or other forms of mitigation are planned for these sites since seven of the sites would be avoided by enclosing the sites within protective fencing during project construction, and one of the sites was destroyed by previous mining disturbance. Data recovery at the five NRHP-eligible prehistoric sites has occurred in three stages: 1) surface artifact collection and remote sensing survey, 2) excavation, and 3) mechanical stripping. The process focuses on locating buried archaeological deposits that could provide answers to project research questions and information that can be added to the local and regional archaeological database. Site descriptions for the five prehistoric sites are provided below.

Site 26EU1533

Site 26EU1533 was originally recorded by the Desert Research Institute (DRI) as a sparse chipped stone scatter (Hicks 1989). P-III Associates, Inc. (P-III) revisited the site in 1992 (Newsome 1992) and recorded a central concentration of debitage surrounded by a diffuse scatter of flakes. In September 2005, SWCA revisited the site and noted that the site appeared to have experienced a range fire and subsequent erosion since the time of P-III's visit in 1992 (Cannon and Stettler 2007). In October 2006, SWCA returned to the site to conduct limited probing, which consisted of two shovel tests and one 1- x 1-meter (m) test unit dug to a depth of 10 cm (Cannon and Stettler 2007). The limited probing resulted in the discovery of an Elko corner-notched point.



Betze Pit Expansion Project

Figure 3.9-1

Native American Traditional Values and Cultural Resources Cumulative Effects Study Area

Site 26EU1539

Site 26EU1539 was first documented by DRI as a low-density lithic scatter with some ground stone (Hicks 1989). In 1992 and 1993, P-III revisited the site and identified additional artifacts and artifact concentrations (Schroedl 1993). SWCA revisited the site in September 2005 and recorded two artifact concentrations and noted previously unrecorded artifacts (Cannon and Stettler 2007). One of the previously unrecorded artifacts included a small side-notched point. In September 2006, SWCA returned to the site and conducted limited probing, which included three 10-cm-deep shovel tests and one 20-cm-deep 1- x 1-m test unit. The limited probing revealed buried lithic artifacts, but no features.

Site 26EU1548

Site 26EU1548 was originally recorded by DRI as a low-to-moderate density lithic scatter with five localized concentrations (Hicks 1989). In 1993, P-III revisited the site and made no changes to the site description; however, they did identify a large biface (Newsome et al. 1993). SWCA revisited the site in September 2005 and found two artifact concentrations (Cannon and Stettler 2007). In September 2006, SWCA returned to the site to conduct limited probing, which consisted of five 10-cm-deep shovel tests and one 30-cm-deep 1- x 1-m test unit. The limited probing revealed buried lithic artifacts, but no features.

Site 26EU2064

Site 26EU2064 was originally recorded by P-III as a dispersed lithic scatter, which included a Humboldt projectile point (Tipps and Popek 1992). In September 2005, SWCA revisited the site and found four artifact concentrations within the originally recorded dispersed lithic scatter (Cannon and Stettler 2007). The following year, SWCA returned to the site to conduct limited probing, which consisted of 27 shovel tests and ten 1-x 1-m test units excavated to a depth of 35 cm below the surface. The limited probing revealed buried lithic artifacts, but no features.

Site 26EU2126

Site 26EU2126 was originally documented by P-III as two lithic concentrations surrounded by a discrete scatter of debitage, which included a Cottonwood point fragment (Tipps and Popek 1992). In September 2005, SWCA revisited the site and found the two originally recorded artifact concentrations (Cannon and Stettler 2007). SWCA returned to the site in September 2006 to conduct limited probing, which consisted of three 10-cm-deep shovel tests and one 30-cm-deep 1- x 1-m test unit. The limited probing revealed buried lithic artifacts and burned artiodactyl bone. (Artiodactyl bones come from a group of even-toed hoofed mammals such as camels, cattle, pigs, and deer.)

Data recovery at the five NRHP-eligible sites proceeded as follows: 1) controlled collection of all artifacts visible on the surface; 2) mechanical mowing of the vegetation; 3) geophysical remote sensing using multiple kinds of techniques (e.g., resistivity, magnetometer, conductivity) with sub-meter resolution necessary for locating small cultural features (e.g., hearths, artifact concentrations, pits); 4) hand excavation of small 1-m square units to confirm and evaluate the remote sensing results and surface indicators of human activities; and 5) mechanical scraping to confirm the absence of additional, undetected cultural features. The field work was completed in fall of 2007. Data analysis and report writing will continue through spring 2008, with a draft report submitted to BLM by July 11, 2008.

3.9.2 Environmental Consequences

The NHPA requires that federal agencies take into account the effect of a proposed undertaking on historic properties. Historic property, as defined by the regulations implementing Section 106, means "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the NRHP maintained by the NPS." Potential effects to historic properties are assessed using the "criteria of adverse effect" (36 CFR 800.5[a][1]), as defined in the implementing regulations for the NHPA. "An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the National Register in a manner that would diminish the integrity of the

property's location, design, setting, materials, workmanship, feeling, or association." The analysis of effects using these criteria is limited to those resources that are listed in the NRHP or have been recommended as eligible.

3.9.2.1 No Action Alternative

Under the No Action Alternative, the proposed facilities that would comprise the Betze Pit Expansion Project would not be developed. The mining and ore processing activities associated with the existing Goldstrike Mine would continue under the terms of current permits and approvals as authorized by the BLM and State of Nevada. No additional ground-disturbing activities beyond those currently authorized would occur at the mine site. Prior to construction of the authorized facilities, adverse effects to NRHP eligible properties located in the area of the facilities were, or would be, fully mitigated in accordance with Section 106 of the NHPA, the 1991 PA, and NEPA. Therefore, no adverse effects to historic properties are anticipated under the No Action Alternative.

3.9.2.2 Proposed Action

Data recovery was completed at five historic properties located in the project area; therefore, under Section 106 of the NHPA, there would be no adverse effects to these properties as a result of the Proposed Action. However, although Section 106 provides for findings of no adverse effect through mitigation, mitigation means lessening of effects to historic properties, not that the properties are not damaged by an undertaking. Even with data recovery, some data about the site, and the site itself, are lost. A principal disadvantage of this form of mitigation is that the recovery process itself is destructive, preventing future opportunities for scientific research, preservation, or public appreciation.

In addition, eight prehistoric sites previously recommended as eligible for the NRHP were located near the project area; however, no data recovery or other forms of mitigation are planned for these sites since seven of the sites would be avoided by enclosing the sites within protective fencing during project construction, and one of the sites was destroyed by previous mining disturbance.

The potential for the discovery of previously unidentified cultural resources during construction activities exists within proposed disturbance areas and could result in direct effects to these unanticipated discoveries. However, if any previously unknown cultural resources are discovered during construction on BLM-administered lands, all construction activities would cease within the vicinity of the discovery, and the BLM Authorized Officer and SHPO would be notified of the find. Steps would be taken to protect the site from vandalism or further damage until the BLM Authorized Officer can evaluate the nature of the discovery as outlined in the PA. Construction would not resume in the area of the discovery until the BLM Authorized Officer has issued a notice to proceed.

If construction or other project personnel discover what may be human remains, funerary objects, or items of cultural patrimony on BLM-administered land, construction would cease within the vicinity of the discovery, and the BLM Authorized Officer would be notified of the find. Any discovered Native American human remains, funerary objects, or items of cultural patrimony found on federal land would be handled in accordance with Native American Grave Protection and Repatriation Act (NAGPRA). Non-Native American human remains would be handled in accordance with Nevada law. Construction would not resume in the area of the discovery until the BLM Authorized Officer has issued a notice to proceed.

If human remains and associated funerary objects are discovered on private land during construction activities, construction would cease within the vicinity of the discovery and the county coroner or sheriff would be notified of the find. Treatment of any discovered human remains and associated funerary objects found on private land would be handled in accordance with the provisions of applicable Nevada law.

An increase in the number of workers during construction could increase the potential for indirect effects at archaeological sites. Indirect effects are difficult to quantify and control. However, they can include the loss of

surface artifacts due to illegal collection and inadvertent destruction, and increased erosion due to soil disturbance associated with construction activities. In accordance with the applicant-committed environmental protection measures and the PA, BGMI would train all of its personnel, and all personnel of its contractors, in their responsibilities to protect cultural resources and enforce BGMI's policy against off-road cross-country travel and the removal of artifacts. Some BGMI personnel have been trained as Nevada Site Stewards who work with other personnel and cultural resource consultants in developing and implementing a program of site stewardship that includes regular monitoring and site visits to assess their condition.

Indirect effects to archaeological resources from modifications to erosion/sedimentation rates during construction activities could occur as a result of the Proposed Action. The development of waste rock piles and other facilities, which alter runoff may indirectly impact surrounding archaeological sites by altering patterns of erosion and groundwater. The development of dryer, wetter, or even more importantly fluctuating soil moisture conditions at sites surrounding the proposed expansion may have adverse effects on preservation conditions (especially of organic remains) at surrounding archaeological sites. Long-term monitoring, as part of the site stewardship program, should enable the BLM to evaluate these types of effects and mitigate effects, as appropriate.

To reduce erosion effects to archaeological sites, construction practices would include soil stabilization and temporary controls to minimize erosion, encourage infiltration, and control sediment discharges (see Section 2.2.1.13, Applicant-committed Environmental Protection Measures). Where necessary, temporary erosion controls would be installed prior to, or immediately following, initial disturbance of the soil and would be maintained until the soil has been stabilized.

3.9.2.3 Bazza Waste Rock Facility Alternative

This alternative would result in the continued use of the existing Bazza Waste Rock Facility and the proposed Clydesdale Waste Rock Facility would not be constructed. Two of the five NRHP-eligible prehistoric sites that have undergone data recovery are located in the area of the proposed Clydesdale Waste Rock Facility. Therefore, under this alternative, two of the five NRHP-eligible sites would not be lost through project construction compared to all five under the Proposed Action.

3.9.3 Cumulative Impacts

The CESA for cultural resources is shown in **Figure 3.9-1.** The CESA boundary was determined by the BLM to include those mines and related facilities that encompass the core area of the Carlin Trend, including areas currently subjected to open pit and underground mining activities. Past, present, and RFFAs are identified in Section 3.1.

3.9.3.1 No Action Alternative

As directed by law, cultural resource inventories were completed for mining and mining exploration involving federal lands within the CESA. A summary of the cultural resource inventories can be found in **Table D-1**, **Appendix D**. Compliance with Section 106 of the NHPA has minimized impacts to cultural resources; however, past and present mining and mining exploration have resulted in cumulative impacts to these resources. Although cultural resource inventories are done in advance of mining exploration and development with the intent of avoiding historic properties, impacts these properties have occurred. Recent re-evaluation of many of the remaining cultural resources within the BGMI operations boundary have shown that some of the historic properties that should have been avoided under the PA have been damaged, and a few completely destroyed (**Table D-2**, **Appendix D**). Once the re-evaluation is completed, site treatment and data recovery plans will be developed and implemented to mitigate the damage and loss.

The development and implementation of treatment plans at historic properties that cannot be avoided or protected typically involves archaeological excavation and other forms of data recovery. Cultural resources represent non-renewable, finite resources that cannot be replaced. Even with data recovery, some data about

the site is lost, especially to future generations of archaeologists who will have new questions and theories to investigate, and new means or methods of doing so. A principal disadvantage of this form of mitigation is that the recovery process itself is destructive, preventing future opportunities for scientific research, preservation, or public appreciation. A list of mitigated sites located within the CESA is included **Table D-3, Appendix D**.

3.9.3.2 Proposed Action

Cumulative effects to cultural resources under the Proposed Action would be similar to the No Action Alternative cumulative impacts discussed above.

3.9.3.3 Bazza Waste Rock Facility Alternative

This alternative would have similar cumulative impacts to cultural resources as discussed above for the No Action Alternative.

3.9.4 Mitigation Measures and Monitoring

All known historic properties identified within the area of potential effect (APE) have been mitigated in accordance with the 1991 PA and data recovery plan prepared for the project. The eight sites to be enclosed within protective fences and the other remaining historic properties that have not undergone data recovery within the POO will be monitored to ensure that additional damage or adverse effects do not occur in any of them. Any previously unknown historic properties that may be discovered during construction activities would be mitigated in accordance with the PA. Therefore, no additional mitigation or monitoring is recommended.

3.9.5 Residual Impacts

The Proposed Action would result in the loss of cultural resources that are not eligible for the NRHP. Although these sites have been recorded to BLM standards and the information has been integrated into local and statewide databases, the sites ultimately are destroyed by project construction. Adverse effects to five NRHP-eligible properties have been mitigated through implementation of data recovery. However, since some of the cultural value associated with these sites cannot be fully mitigated, the Proposed Action and Bazza Waste Rock Facility Alternative would result in a residual impact to these resources. No residual adverse effects to cultural resources, including NRHP eligible properties are anticipated under the No Action Alternative.

3.10 Native American Traditional Values

3.10.1 Affected Environment

The analysis area for Native American Traditional Values encompasses the project boundary. The CESA encompasses the hydrologic study area (**Figure 3.9-1**). The boundary for the CESA includes water sources important to the Western Shoshone, as well as edible/medicinal plants, minerals, wildlife, and traditional/cultural/religious use sites.

3.10.1.1 Regulatory Framework

Federal law and agency guidance require BLM to consult with Native American tribes concerning the identification of cultural values, religious beliefs, and traditional practices of Native American people that may be affected by actions on BLM-administered lands. This consultation includes the identification of places (i.e., physical locations) of traditional cultural importance to Native American tribes. Places that may be of traditional cultural importance to Native American people include, but are not limited to:

- Locations associated with the traditional beliefs concerning tribal origins, cultural history, or the nature of the world;
- Locations where religious practitioners go, either in the past or the present, to perform ceremonial activities based on traditional cultural rules or practice;
- Ancestral habitation sites;
- Trails, burial sites; and
- Places from which plants, animals, minerals, and waters possessing healing powers or used for other subsistence purposes, may be taken.

Some of these locations may be considered sacred to particular Native American individuals or tribes.

In 1992, the NHPA was amended to explicitly allow that "properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization may be determined to be eligible for inclusion on the NRHP." If a resource has been identified as having importance in traditional cultural practices and the continuing cultural identity of a community, it may be considered a traditional cultural property (TCP). The term "traditional cultural property" first came into use within the federal legal framework for historic preservation and cultural resource management in an attempt to categorize historic properties containing traditional cultural significance. To qualify for nomination to the NRHP, a TCP must:

- Be more than 50 years old;
- Be a place with definable boundaries;
- Retain integrity; and
- Meet certain eligibility criteria as outlined for cultural resources in the NHPA (see Section 3.9, Cultural Resources).

In addition to NRHP eligibility, some places of cultural and religious importance also must be evaluated to determine if they should be considered under other federal laws, regulations, directives, or policies. These include, but are not limited to, the NAGPRA of 1990, American Indian Religious Freedom Act (AIRFA) of 1978, Archaeological Resources Protection Act (ARPA) of 1979, and EO 13007 of 1996.

NAGPRA established a means for Native Americans, including Indian Tribes, to request the return of human remains and other sensitive cultural items held by federal agencies or federally assisted museums or institutions. NAGPRA also contains provisions regarding the intentional excavation and removal of, inadvertent

discovery of, and illegal trafficking in Native American human remains and sensitive cultural items located on federal lands.

AIRFA established a federal policy of protecting and preserving the inherent right of individual Native Americans to believe, express, and exercise their traditional religions including, but not limited to, access to sites, use and possession of sacred objects, and the freedom to worship through ceremonial, and traditional rites.

ARPA requires notification of the appropriate Indian tribe before approving a cultural resource use permit for the excavation (testing and data recovery) of archaeological resources, if the responsible federal land manager determines that a location having cultural or religious importance to the tribe may be harmed or destroyed.

EO 13007 defines a sacred site as any specific, discrete, narrowly delineated location on federal land that is identified by an Indian tribe, or Indian individual determined to be an appropriately authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, an Indian religion, provided that the tribe or appropriate authoritative representative has informed the federal agency of the existence of such a site.

EO 13007 requires federal agencies "to the extent practicable, permitted by law, and not clearly inconsistent with essential agency functions, to "(1) accommodate access to and ceremonial use of such sacred sites by Indian religious practitioners and (2) avoid adversely affecting the physical integrity of such sacred sites." To implement these requirements, federal agencies must, "where practicable and appropriate," . . . "implement procedures, . . . to ensure reasonable notice is provided of proposed actions or land management policies that may restrict future access to or ceremonial use of, or adversely affect the physical integrity of, sacred sites."

3.10.1.2 Native American Consultation

In compliance with the NHPA, as amended, the BLM initiated government-to-government consultation for the Betze Pit Expansion Project SEIS on April 24, 2007, by sending letters to the following federally recognized tribes/bands: Te-Moak Tribe of Western Shoshone, Duckwater Shoshone Tribe, Ely Shoshone Tribe, Yomba Shoshone Tribe, Duck Valley Sho-Pai Tribes of Idaho and Nevada, Battle Mountain Band Council, Wells Band Council, South Fork Band Council, and Elko Band Council. Letters were sent to inform the various tribes of the proposed undertaking and to inquire whether the tribes:

- Wish to arrange a meeting;
- Require more information about the project;
- Want to enter into formal consultation; or
- Want to attend a field tour of the proposed project area.

In addition, the BLM sent letters to the Western Shoshone Defense Project and the Western Shoshone Committee of Duck Valley to inform them of the project. **Table 3.10-1** lists the tribes and groups that have been contacted and summarizes the current status of consultation and the concerns they have identified regarding the proposed project. BLM organized two tours for Native American elders to visit the project area including the five sites under-going data recovery, but no elders showed up for the tours. The field work was completed before the tours could be rescheduled.

Table 3.10-1 Summary of Native American Consultation

Name of Tribe	Date of Contact	Follow-up Contact	Status
Te-Moak Tribe of Western Shoshone	April 24, 2007	July 25, 2007	Tribal representative asked for and received a second copy of the 4/24/07 introduction letter to present again to the Council along with a date for a meeting or field visit.
Duckwater Shoshone Tribe	April 24, 2007	July 24, 2007	No response to date.
Ely Shoshone Tribe	April 24, 2007	July 24, 2007	Tribe declined to participate in consultation. No issues or concerns were identified.
Yomba Shoshone Tribe	April 24, 2007	July 24, 2007	Tribal representative recommended that BLM contact the tribal Chairperson. No response to date.
Duck Valley Sho-Pai Tribes of Idaho and Nevada	April 24, 2007	May 1, 2007 July 25, 2007 Sept. 19, 2007 October 1, 2007	BLM requested a meeting with tribal representatives. A field visit was arranged for 10/1/07. The field visit was cancelled when none of the representatives were able to attend. At this time, the visit has not been rescheduled.
Battle Mountain Band Council	April 24, 2007	July 25, 2007 July 27, 2007	No response to date.
Wells Band Council	April 24, 2007	July 24, 2007	No response to date.
South Fork Band Council	April 24, 2007	July 24, 2007	No response to date.
Elko Band Council	April 24, 2007	July 25, 2007 August 7, 2007 August 8, 2007 August 10, 2007 August 23, 2007 August 27, 2007 Sept. 17, 2007 Sept. 19, 2007 October 1, 2007	Tribal representatives requested tribal monitor/observer participation in data recovery at five historic properties in the APE. The qualified observer was not available. Tribal representatives requested a field visit. Field visit was arranged for 10/1/07. The field visit was cancelled when none of the representatives were able to attend. At this time, the visit has not been rescheduled.
Western Shoshone Defense Project (WSDP)	April 24, 2007		No response to date.
Western Shoshone Committee of Duck Valley	April 24, 2007		No response to date.

Source: Dixon 2007.

3.10.2 Environmental Consequences

The effects of federal undertakings on TCPs or places of religious or cultural importance to contemporary Native Americans are given consideration under the provisions of EO 13007, AIRFA, NAGPRA, and recent amendments to the NHPA. As amended, the NHPA now integrates Indian tribes into the Section 106 compliance process, and also strives to make the NHPA and NEPA processes procedurally compatible. Furthermore, under NAGPRA, culturally affiliated Indian tribes and federal agencies jointly may develop procedures to be taken when Native American human remains are discovered on federal lands.

3.10.2.1 No Action Alternative

Under the No Action Alternative, the proposed facilities that would comprise the Betze Pit Expansion Project would not be developed. The mining and ore processing activities associated with the existing Goldstrike Mine would continue under the terms of current permits and approvals as authorized by the BLM and State of Nevada. No additional ground-disturbing activities beyond those currently authorized would occur at the mine site. Prior to construction of the authorized facilities any adverse effects to TCPs and places of cultural or religious importance located in the area of the facilities would be, fully mitigated in accordance with Section 106 of the NHPA and other appropriate laws that protect these resources. To date, no other tribes have responded to the letters, and no TCP or place of cultural or religious importance has been identified through inventory or by the contacted tribes. Therefore, no adverse effects to Native American Traditional Values are anticipated under the No Action Alternative.

3.10.2.2 Proposed Action

Government-to-government consultation between the BLM Elko District Office and tribal representatives was initiated on April 24, 2007, and currently is ongoing. The Duck Valley Sho-Pai Tribes of Idaho and Nevada and the Elko Band Council requested a field visit to the project area. A visit was scheduled for October 1, 2007; however, the field visit was cancelled after none of the tribal representatives were able to attend. At this time, the field visit has not been rescheduled. The ElkoBand Council proposed a monitor/observer be present, but a qualified server was not available. To date, no other tribes have responded to the letters, and no TCP or place of cultural or religious importance has been identified through inventory or by the contacted tribes.

If a TCP or place of cultural or religious importance is identified by tribal representatives, no surface disturbance would occur within or immediately adjacent to the boundary of the property prior to completion of all consultation required by law. If data recovery or other form of mitigation is required at a TCP or place of cultural or religious importance, a data recovery or mitigation plan would be reviewed and approved by the BLM and SHPO. Tribal representatives would be asked to participate in the development of any such data recovery or mitigation plan. Therefore, no adverse effects to Native American traditional values are anticipated as a result of the Proposed Action.

3.10.2.3 Bazza Waste Rock Facility Alternative

This alternative would result in the continued use of the existing Bazza Waste Rock Facility and the proposed Clydesdale Waste Rock Facility would not be constructed. For this alternative, potential impacts to Native American traditional values would be the same as those described for the Proposed Action. To date, no TCPs or places of cultural or religious importance to Native Americans have been identified through inventory or by the tribes participating in the government-to-government consultation process.

3.10.3 Cumulative Impacts

The CESA for Native American Traditional Values is shown in **Figure 3.9-1**. Past, present, and RFFAs are identified in Section 3.1.

3.10.3.1 No Action Alternative

Tribal consultation and research conducted for previous EAs and EISs resulted in the identification of general issues that require consideration as part of the cumulative impacts assessment. Those general issues include water, sage-grouse, and cultural sites, including NRHP-eligible sites, TCPs, and places of cultural or religious importance. Potential cumulative impacts to these resources are discussed below.

Impacts to Water Resources

Although it is not possible to conclusively identify specific springs and seeps that would or would not be impacted by future mine-induced drawdown or to predict the areal extent of the cumulative drawdown area resulting from the various mine activities in the CESA, it is anticipated that cumulative effects to water sources would be most likely to occur within the cumulative mine-related 10-foot groundwater drawdown contour. The degree to which mine-related impacts to perennial waters in the regional cumulative effects study area have affected, or would affect, Native American traditional values cannot be specifically quantified. However, it is most likely that impacts to perennial streamflows and flows from springs would be within the area of the cumulative predicted 10-foot drawdown contour, as shown on **Figures 3.3-26** and **3.3-48** in the discussion for water resources. This figure indicates spring locations and the extent of perennial streams within the most probable area of cumulative effects. Impacts would include reductions in the amount of flow, as well as in the seasonal duration of flow, from springs and in perennial streams.

Western Shoshone religion is based on the belief that all life is interdependent. Human beings are recognized to have kin ties with other life forms and with the earth itself. This belief system is very important to the Western Shoshone in the Great Basin where a delicate balance must be maintained between human subsistence and an unpredictable, sometimes harsh environment (Rusco 2000). The scarcity and unpredictability of water in this semi-arid region may account for the importance of water in Western Shoshone religion. Water is the keystone of Western Shoshone religion because power (Puha), with its affinity for life, is strongly attracted to water (Rusco 2000). As a result, it is assumed that Western Shoshone traditional lifeways as they relate to perennial waters have been, and would continue to be, cumulatively affected by mine-related activity that has occurred, and would occur, in the regional cumulative effects study area.

The potential cumulative impacts from dewatering have been addressed in the CIA (BLM 2000b) and Betze SEIS (BLM 2000a, 2003b) and were previously mitigated (**Figure 3.3-48** and Section 3.3.4.2). This mitigation may not address impacts to Native American values as they relate to water resources. However, no impacts have been identified to date. For an expanded discussion on impacts to water resources in the cumulative effects study area, the reader is referred to Section 3.3, Water Resources and Geochemistry.

Impacts to Sage-grouse

Animals are of particular importance to the Western Shoshone. Many species continue to be an important subsistence resource. Actions addressed by the cumulative effects analysis could impact the abundance and distribution of animal species and their habitat. Of particular concern to the Western Shoshone is the ongoing regional decline of sage-grouse and their habitat (BLM 2000a). Sage-grouse are considered sacred, and the hunting of these birds is important in preserving Western Shoshone cultural identity and traditions.

A total of 14 greater sage-grouse leks have been identified within the Native American CESA. Nesting habitat for sage-grouse is known to occur in valley bottoms and foothill areas. Nesting habitat is found throughout the CESA, but is mainly concentrated in the northern portion. Summer and winter range occurs throughout the CESA, excluding lower portions of Boulder Valley.

Cumulative impacts to greater sage-grouse primarily would be directly related to habitat loss, habitat fragmentation, and animal displacement. Many of the greater sage-grouse populations that occur in the CESA would continue to occupy their respective ranges and breed successfully, although population numbers may decrease relative to the amount of cumulative habitat loss and disturbance from incremental development.

Indirect impacts associated with human presence and noise incrementally would increase in the CESA during the life of the proposed mine expansion. The contribution of the Proposed Action and Bazza Waste Rock Facility Alternative to these impacts would be short-term and temporary and would cease following completion of operations and final reclamation.

Impacts to Cultural Sites

As a result of previous cultural resource inventories conducted throughout the CESA, a large number of cultural sites have been documented. The sites primarily consist of lithic debitage, tool scatters, and debitage scatters. The lithic debitage and tool scatters contain fragments of stone implements, while debitage scatters contain stone waste flakes, which are a byproduct of tool making. Other cultural sites or resources include (and are not limited to) red and white clay sources, rock shelters, village sites, projectile points, ground stone, and TCPs (e.g., Tosawihi Quarry, Rock Creek). According to the Western Shoshone, cultural sites are associated with the ancestors and considered "physical proof of Shoshone existence" or physical expressions of cultural identity.

The impact analysis of the Proposed Action and Bazza Waste Rock Facility Alternative indicates no adverse impacts to cultural sites based on compliance with the NHPA, the PA, and implementation of mitigating measures involving data recovery (i.e., archaeological excavation), along with collection of all important artifacts with detailed recording of their context. Therefore, under NEPA, no cumulative effects to cultural sites would occur as a result of the Proposed Action. However, archaeological excavation is perceived by some Western Shoshone as part of a destructive process that permanently removes Western Shoshone heritage and the ancestors themselves (Rucks 2004). Therefore, within the context of Native American concerns, it is anticipated that cumulative effects to cultural sites as a result of mining and other human activity would continue as cultural sites are excavated.

3.10.3.2 Proposed Action

At this time, none of the tribes participating in the ongoing government-to-government consultation process have identified any issues specific to the Proposed Action; however, impacts to water resources, to sage-grouse, and to cultural sites are likely to be of concern to tribes. Cumulative effects to Native American Traditional Values for this alternative are similar to the cumulative impacts discussed for the No Action Alternative.

3.10.3.3 Bazza Waste Rock Facility

Cumulative impacts to Native American Traditional Values for this alternative are similar to the Proposed Action as discussed in Section 3.10.3.2.

3.10.3.4 Mitigation Measures and Monitoring

At this time, no TCP or place of cultural or religious importance has been identified by tribal representatives participating in the ongoing Native American consultation. If tribal representatives were to identify sites of tribal importance, these resources would be protected in compliance with Section 106 of the NHPA and NEPA. Therefore, no additional monitoring or mitigation measures are recommended.

3.10.4 Residual Impacts

No residual adverse effects to Native American Traditional Values are anticipated for the Proposed Action or alternatives. At this time, no TCP or place cultural or religious importance has been identified by the tribes participating in government-to-government consultation or through cultural resources inventories conducted in the study area. If any TCP or place of cultural or religious importance were identified in the study area, the resource would be protected in compliance with Section 106 of the NHPA and other appropriate laws that protect these resources.

3.11 Air Quality

3.11.1 Affected Environment

The Goldstrike Mine is located entirely within the Boulder Flat Air Quality Basin (No. 61 - Upper). The study area for air quality encompasses the proposed project boundary and the area within 6 miles of the proposed project. The CESA encompasses the 100-km radius from the Goldstrike Mine (**Figure 3.11-1**).

Nevada has great climatic diversity, ranging from scorching lowland desert in the south to cool mountain forests in the north. Its varied and rugged topography, mountain ranges, and narrow valleys range in elevation from approximately 1,500 to more than 10,000 feet amsl. Large local variations of temperature and rainfall are common.

Nevada lies on the eastern, lee side of the Sierra Nevada Range, a massive mountain barrier that markedly influences the climate. One of the greatest contrasts in precipitation found within a short distance in the U.S. occurs between the western slopes of the Sierras in California and the valleys just to the east of this range. The prevailing winds are from the west. As the warm moist air from the Pacific Ocean ascends the western slopes of the Sierra Range, the air cools, condensation takes place, and most of the available moisture falls as precipitation. As the air descends the eastern slope, it is warmed by compression, and very little precipitation occurs. The effects of this mountain barrier are felt throughout the state, with the result that the lowlands of Nevada are largely desert or steppes. The principal climatic features are bright sunshine; low annual precipitation (averaging 9 inches in the valleys and deserts), heavy snowfall in the higher mountains; clean, dry air; and exceptionally large daily temperature ranges.

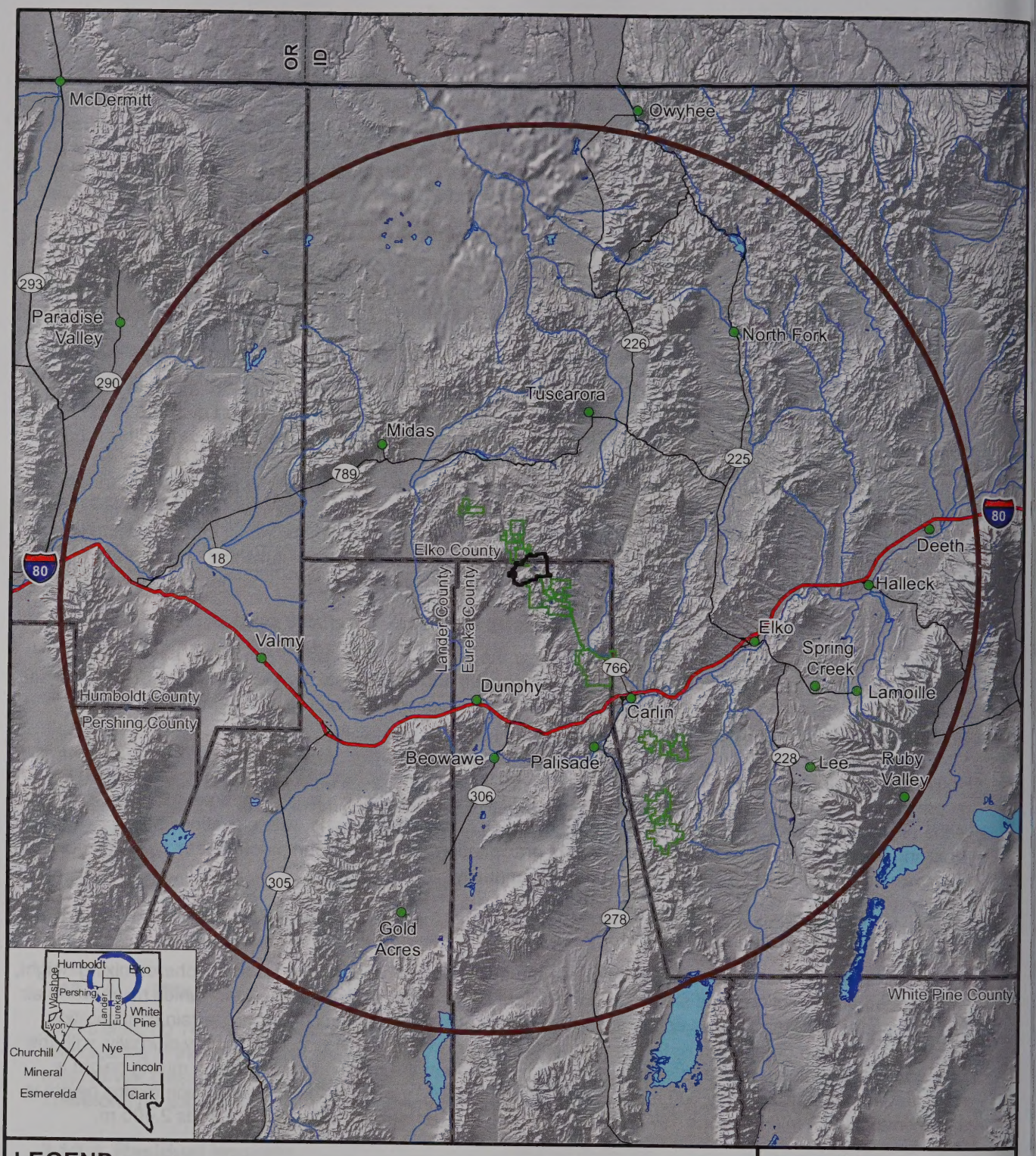
The Betze Pit Expansion Project area is located near the north-central portion of the Great Basin. The surrounding terrain consists of alternating mountain ranges and sagebrush-covered valleys, with the mine site situated in the Basin and Range physiographic province. Elevations at the project location range from approximately 6,000 feet to 7,000 feet amsl.

Regional meteorology, air quality, and dispersion conditions at the project site are characterized from data records from the closest climate monitoring station at Elko, Nevada, which is approximately 45 miles southeast of the proposed project. The climate in the project region is classified as arid, with elevations below 6,500 feet receiving approximately 5 to 9 inches per year of precipitation, while the mountainous areas typically receive approximately 11 to over 16 inches of precipitation annually.

3.11.1.1 Climatology and Meteorology

Three important meteorological factors influence the dispersion of pollutants in the atmosphere: mixing height, wind (speed and direction), and stability. Mixing height is the height aboveground within which rising warm air from the surface will mix by convection and turbulence. Local atmospheric conditions, terrain configuration, and source location determine dilution of pollutants in this mixed layer. Mixing heights vary diurnally, with the passage of weather systems and season. For the project area, the mean annual morning mixing height is estimated to be approximately 300 m. However, during the winter months the mean morning mixing height is approximately 220 m (Holzworth 1972). The mean annual afternoon mixing height exceeds 2,400 m.

Morning atmospheric stability conditions tend to be stable because of the cooling of the air layers nearest the ground. Afternoon conditions, especially during the warmer months, tend to be neutral to unstable because of the rapid heating of the surface under clear skies. During the winter, periods of stable afternoon conditions may persist for several days in the absence of synoptic (continental-scale) storm systems to generate higher winds with more turbulence and mixing. A high frequency of inversions at lower elevations during the winter



LEGEND

- Air Quality Cumulative Effects Study Area
- Goldstrike Mine Operations Boundary
- Mine Plan Boundaries
- Towns
- Lakes and Reservoirs
- Rivers

Source: BLM 2007b,c.

N

0 6.25 12.5 25 Miles

Betze Pit Expansion Project

Figure 3.11-1

Air Quality Cumulative Effects Study Area

06/20/2008

can be attributed to the nighttime cooling and sinking air flowing from higher elevations to the low lying areas in the basins. Although winter inversions are generally quite shallow, they tend to be more stable because of reduced surface heating.

The proposed project is located at a latitude that places it within the belt of prevailing westerly winds that circle the globe around the earth's northern hemisphere. However, the Goldstrike Mine is located in complex terrain where the winds are affected by local topographic features.

Due to the typically dry atmosphere, bright sunny days and clear nights frequently occur. This in turn allows rapid heating of the ground surface during daylight hours and rapid cooling at night. Because heated air rises, and cooled air sinks, winds tend to blow uphill during the daytime and down slope at night. The complexity of terrain features causes complex movements in the cyclic air patterns, with thin layers of moving air embedded within the larger scale movements. The lower level, thermally driven winds also are embedded within larger scale upper wind systems (synoptic winds). Synoptic winds in the region are predominantly west to east, are characterized by daily weather variations that enhance or diminish the boundary layer winds, and are channeled by regional and local topography.

The wind rose for Elko (**Figure 3.11-2**) is representative of the regional wind climatology. The Elko wind rose indicates that winds are predominantly from the west to southwest, but it also shows that there is a secondary maximum of wind occurrences from the northeast. Wind speed has an important effect on area ventilation and the dilution of pollutant concentrations from individual sources. Light winds, in conjunction with large source emissions, may lead to an accumulation of pollutants that can stagnate or move slowly to downwind areas. During stable conditions, downwind usually means down valley or toward lower elevations. Climate data from Elko indicate that the potential for air pollution episodes to last 5 or more days is nearly zero (Holzworth 1972). A potential air pollution episode is defined as a period of time with wind speeds less than 2 m per second and mixing heights less than 1,000 m.

Table 3.11-1 shows the monthly climate summary data for temperature and precipitation for Elko during the 117-year period from January 1890 through June 2007. Summers are typically hot and dry. Precipitation falls throughout the year with much of it occurring as snowfall during the winter. The average annual precipitation at Elko is approximately 9.6 inches.

Table 3.11-1 Monthly Climate Summary Elko WB Airport, Nevada[1]

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (°F)	36.7	42.5	51.0	60.0	69.5	80.1	91.0	88.8	78.7	65.9	50.2	39.0	62.8
Average Min. Temperature (°F)	10.8	17.3	23.6	29.1	35.6	42.2	48.1	45.6	36.6	27.9	20.4	13.2	29.2
Average Total Precipitation (in.)	1.18	0.94	0.92	0.84	0.98	0.77	0.38	0.41	0.45	0.71	0.93	1.09	9.59
Average Total Snow Fall (in.)	7.8	4.5	3.7	1.6	0.5	0.0	0.0	0.0	0.0	0.5	3.2	6.2	28.0
Average Snow Depth (in.)	2	1	0	0	0	0	0	0	0	0	0	1	0

[1]Period of Record: 1/1/1890 to 6/30/2007.

Source: National Climatic Data Center – National Weather Service Cooperative Network 2007.

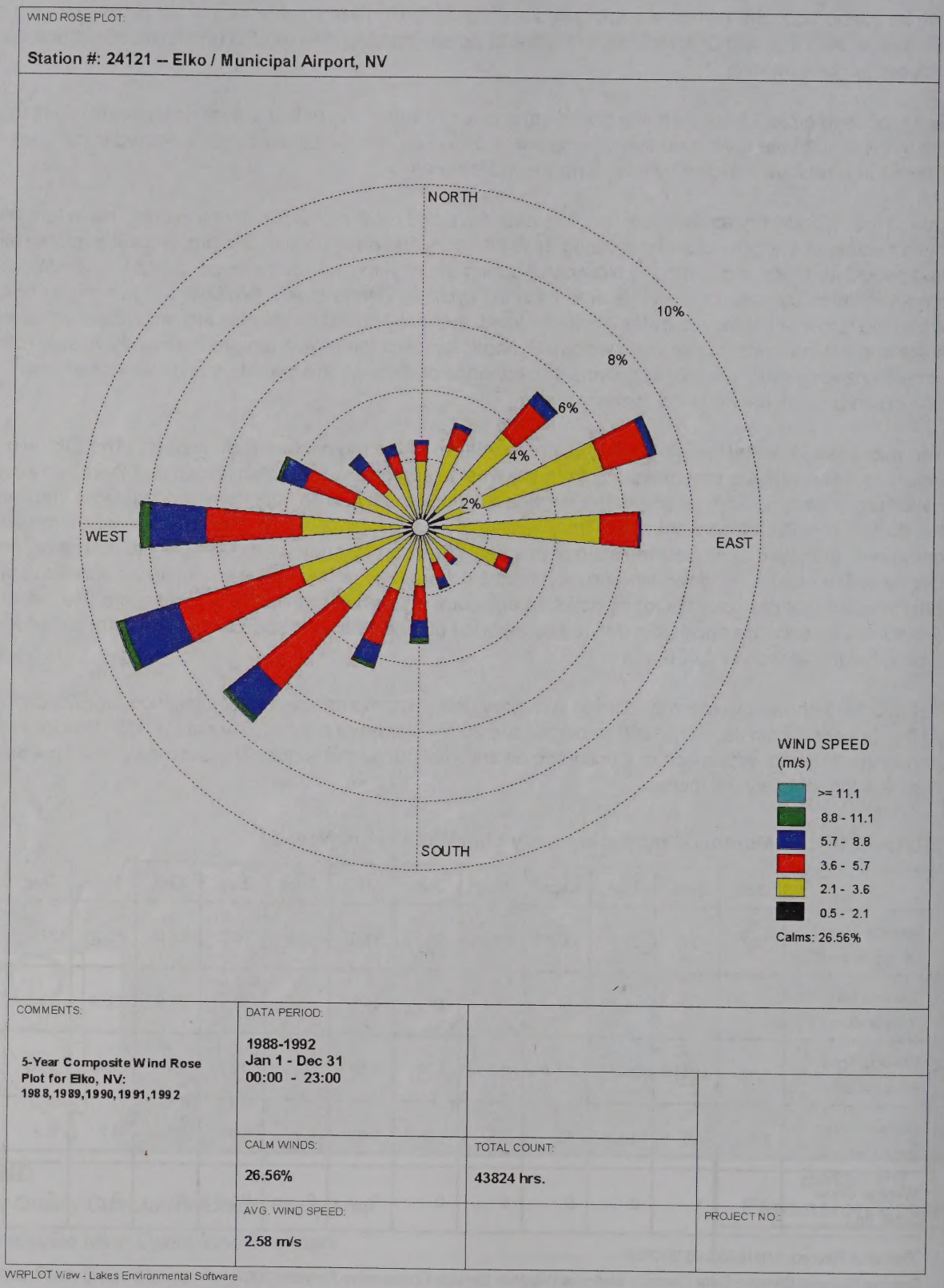


Figure 3.11-2 Elko Wind Rose Diagram

One year of on-site data from the Goldstrike Mine North Block meteorology station is in close agreement with the long-term record at Elko. Goldstrike maximum temperatures and precipitation are very similar to Elko records. Average minimum temperatures at the mine are somewhat higher than at the Elko site. **Table 3.11-2** shows data from the North Block meteorology station for the period December 2006 through November 2007.

Table 3.11-2 Goldstrike Mine North Block Meteorology Station Data

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Average Max. Temperature (°F)	29.8	40.5	53.4	54.2	68.9	79.6	91.0	86.1	72.7	58.6	50.0	38.0	60.3
Average Min. Temperature (°F)	16.3	27.2	34.9	35.6	45.7	53.9	67.3	61.9	50.1	39.4	32.1	24.9	40.8
Average Total Precipitation (in.)	0.3	1.9	0.8	1.6	0.4	0.5	0.4	0.0	0.7	0.6	0.8	1.1	9.1

Source: BGMI 2007a.

3.11.1.2 Air Quality

Air quality is defined by the concentration of various pollutants and their interactions in the atmosphere. Pollution effects on receptors have been used to establish a definition of air quality. Measurement of pollutants in the atmosphere is expressed in units of ppm or micrograms per cubic meter ($\mu g/m^3$). Both long-term climatic factors and short-term weather fluctuations are considered air quality conditions because they control dispersion and affect concentrations. Physical effects of air quality depend on the characteristics of the receptors and the type, amount, and duration of exposure. Air quality standards specify acceptable upper limits of pollutant concentrations and duration of exposure. Air pollutant concentrations within the standards generally are not considered to be detrimental to public health and welfare.

The relative importance of pollutant concentrations can be determined by comparison with appropriate national and/or state Ambient Air Quality Standards (AAQS). National and state AAQS are presented in **Table 3.11-3**. An area is designated by the USEPA as being in attainment for a pollutant if ambient concentrations of that pollutant are below the national AAQS. An area is not in attainment if violations of national AAQS for that pollutant occur. Areas where insufficient data are available to make an attainment status designation are listed as unclassifiable and are treated as being in attainment for regulatory purposes.

The existing air quality of the project area is typical of the largely undeveloped regions of the western U.S. For the purposes of statewide regulatory planning, this area has been designated as in attainment (not exceeding NAAQS for criteria pollutants) for all pollutants that have an AAQS. Current sources of air pollutants in the region include several precious metals mines that are sources for particulate matter (PM) with aerodynamic diameters (in micrometers) designated as PM_{10} and $PM_{2.5}$.

Global Mercury

Mercury is a naturally occurring element in many soils, volcanic rocks, and marine and geothermal water sources. It assumes many forms and can be found naturally in the environment as free metallic mercury, chemically combined with other elements in a number of soil or rock types, and in the form of methylmercury in plants and animals. Mercury is generally present in the atmosphere in one of three chemical forms: gaseous elemental mercury, reactive gaseous mercury, or particulate mercury. Reactive gaseous mercury and particulate mercury account for less than 2 percent of the total concentration in air, with elemental mercury accounting for more than 98 percent of the total (Fitzgerald et al. 1991).

Table 3.11-3 National and State of Nevada Ambient Air Quality Standards

	Nevada Standards		National Standards	
Pollutant	**Averaging Time**	**Concentration ($\mu g/m^3$)**	**Primary ($\mu g/m^3$)**	**Secondary ($\mu g/m^3$)**
O_3	8-Hour	157	157	157
CO	1-Hour	40,000	40,000	40,000
CO less than 5,000 feet amsl	8-Hour	10,000	10,000	10,000
CO at or greater than 5,000 feet amsl	8-Hour	6,670		
SO_2	3-Hour	1,300	None	1,300
SO_2	24-Hour	365	365	None
SO_2	Annual Average	80	80	None
Nitrogen Dioxide (NO_2)	Annual Average	100	100	100
PM_{10}	24-Hour	150	150	150
PM_{10}	Annual Average	50	50	50
$PM_{2.5}$	24-Hour	35	35	35
$PM_{2.5}$	Annual Average	15	15	15
Lead	Quarterly Arithmetic Mean	1.5	1.5	1.5
Hydrogen Sulfide	1-Hour	112	–	–
Visibility	Observation	Insufficient amount to reduce the prevailing visibility to less than 30 miles when humidity is less than 70 percent.	–	–

Source: NAC 445B.22097 Standards of Quality for Ambient Air (NRS 445B.210, 445B.300).

Mercury emissions to the atmosphere come from both background and man-made or anthropogenic sources. Background sources of mercury include natural sources such as naturally enriched soils and volcanoes. There are both global and local anthropogenic sources of mercury. The fate of mercury emissions follows a progression from the emission source to transport, deposition, exposure, and potential human risks. From a single source such as a power plant or a mine, a portion of the emissions are deposited locally near the source while the remaining portion of the mercury is dispersed regionally and globally.

Understanding mercury speciation is important in understanding the deposition and bioaccumulation of mercury in the environment. Gaseous mercury (Hg^0) must be transformed to particulate or oxidized mercury in order to contribute substantially to mercury deposition and subsequent entry into water bodies where further transformation to methylmercury (CH_3Hg^+) can make the mercury available in the aquatic food chain (Porcella 1994). The final pathway to humans for mercury exposure is through the eating of fish with methylmercury stored in their flesh. About 0.3 percent of the total mercury emitted from a point source is deposited in lakes and streams to form a methylmercury compound (Porcella 1994).

Gaseous elemental mercury is a relatively non-reactive chemical form that is not very soluble in water. This form of mercury travels the farthest and can be transported on wind currents for months to years if not oxidized, providing an opportunity for global transport and dispersion. Concentrations of mercury in the air are usually low and of little direct concern. However, atmospheric mercury falls to earth through rain or snow and enters lakes, rivers, and estuaries. Once there, it can transform to its most toxic form, methylmercury, and accumulate in fish and animal tissues.

Mercury accumulates most efficiently in aquatic species. Predatory species at the top of the aquatic food chain generally have higher mercury concentrations. Nearly all of the mercury that accumulates in fish tissue is methylmercury. Inorganic mercury, which is less efficiently absorbed and more readily eliminated from the body than methylmercury, does not tend to bio-accumulate.

Oxidized or reactive gaseous mercury has an average atmospheric residence time of days to weeks (less in the presence of precipitation or bromine compounds often present in saline water bodies). It is not easily volatilized and is very water-soluble. It is easily taken up in precipitation or adsorbed on small particles in the atmosphere and falls out as wet or dry deposition. This form of mercury has a higher potential to enter the food chain and result in concerns related to fish and waterfowl consumption.

Particulate mercury has an average atmospheric residence time of hours to days (depending on the presence or absence of precipitation and the particle size). It has low volatility and is easily taken up in precipitation or adsorbed on small particles, falling out relatively close to the emission source in the presence of precipitation, or as dry deposition that may be transported for longer distances if associated with very small particle sizes. Particle-bound mercury is relatively stable and is not easily converted to CH_3Hg^+ (USEPA 1997).

Local Mercury

When bound in mineral forms that typically appear in ore (e.g., cinnabar), mercury is a stable compound that remains in solid form. Ore processing has the potential to liberate mercury from these stable minerals by dissolving it in process solutions. Because it has a boiling point of 675°F, mercury has the potential to volatilize into a gaseous form when subjected to thermal processes in a recovery and refining circuit.

3.11.2 Environmental Consequences

Issues related to air quality include potential impacts associated with project-generated air emissions.

3.11.2.1 Regulatory Framework and Associated Impacts

Ambient air quality and the emission of air pollutants are regulated under both federal and State of Nevada laws and regulations as discussed below.

Federal Clean Air Act

The Federal Clean Air Act (CAA), and the subsequent Federal Clean Air Act Amendments of 1990 (CAAA), require the USEPA to identify NAAQS to protect public health and welfare. The CAA and the CAAA established NAAQS for seven pollutants, known as "criteria" pollutants. The ambient standards set for these pollutants satisfy "criteria" specified in the CAA. A list of the criteria pollutants regulated under the CAA and their currently applicable NAAQS set by the USEPA are listed in **Table 3.11-3**.

In addition to the designations relative to conforming with the NAAQS, the CAA requires the USEPA to place selected areas within the U.S. into one of three classes, which are designed to limit the deterioration of air quality when it is "better than" the NAAQS. Class I is the most restrictive air quality category. It was created by Congress to prevent further deterioration of air quality in national parks and wilderness areas of a given size, which were in existence prior to 1977, or those additional areas that have since been designated Class I under

federal regulations (40 CFR 52.21). All remaining selected areas outside of the designated Class I boundaries were designated Class II areas, which allow a relatively greater deterioration of air quality, although still below NAAQS. No Class III areas have been designated.

Federal Prevention of Significant Deterioration (PSD) regulations limit the maximum allowable increase in ambient particulate matter in a Class I area resulting from a major or minor kind of stationary source to 4 $\mu g/m^3$ (annual geometric mean) and 8 $\mu g/m^3$ (24-hour average). Increases in other criteria pollutants are similarly limited. Specific types of facilities (listed facilities) that emit, or have the potential to emit, 100 tpy or more of total PM, PM_{10}, or other criteria air pollutants, or any facility that emits, or has the potential to emit, 250 tpy or more of total PM, PM_{10}, or other criteria air pollutants, are considered major stationary sources. Major stationary sources are required to notify federal land managers of Class I areas, which may be affected by the emissions from the source within 100 km (62 miles) of the major stationary source. There are no Class I areas within 100 km of the study area. The nearest Class I planning area to the study area, the Jarbidge Wilderness, is located approximately 190 km (118 miles) northeast of the study area.

Emissions of $PM_{2.5}$ for mining sources are considered a fraction of PM_{10} emissions. $PM_{2.5}$ impacts to local air quality are not modeled due to secondary formation of fine particulates.

The PSD increments are triggered for a planning area when a PSD application for a major source or modification affecting that planning area has been deemed complete by the regulatory authority (40 CFR 52.21[b][14]). The closest triggered planning area (Air Pollution Control Region 61L) is located to the south of the project boundary. The planning area in which the proposed project would be located has not been triggered for any pollutant. New Source Performance Standards (NSPSs), also required under the CAA, are set by the USEPA for specific types of new or modified stationary sources. NSPSs set fixed emission limits for classes of sources to prevent deterioration of air quality from the construction of new sources and to reduce control costs by building pollution controls into the initial design of sources. Certain project components used to process metallic minerals are subject to the NSPSs found in 40 CFR Part 60, Subpart LL (Standards of Performance for Metallic Mineral Processing Plants).

The CAAA introduced a new facility-wide permitting program known as the Federal Operating Permit, or "Title V," program. The program requires facilities with the potential to emit more than 100 tpy of any regulated pollutant (excluding PM), 10 tpy of any single HAP, or 25 tpy or more of any combination of HAPs, to submit a Federal Operating Permit application. The Goldstrike Mine currently has a Title V Federal Operating Permit.

The CAA directs the USEPA to delegate primary responsibility for air pollution control to state governments, which comply with certain minimum requirements. State governments, in turn, sometimes delegate this responsibility to local or regional governmental organizations. The State Implementation Plan (SIP) was originally the mechanism by which a state set emission limits and allocated pollution control responsibility to meet the NAAQS. The function of a SIP broadened after passage of the CAAA and now includes the implementation of specific technology-based emission standards, permitting of sources, collection of fees, coordination of air quality planning, and prevention of significant deterioration of air quality within regional planning areas and statewide. Section 176 of the CAA, as amended, requires that federal agencies must not engage in, approve, or support in any way any action that does not conform to a SIP for the purpose of attaining AAQS (USEPA 2008).

Nevada State Air Quality Program

The BAPC is the agency in the State of Nevada that has been delegated the responsibility for implementing a SIP (excluding Washoe and Clark counties, which have their own SIP). Included in the SIP are the State of Nevada air quality permit programs (NAC 445B.001 through 445B.3497, inclusive). The Nevada AAQS also are part of the SIP. The Nevada AAQS generally are identical to the NAAQS. In addition to establishing the Nevada AAQS, the BAPC is responsible for permit and enforcement activities throughout the State of Nevada.

The BAPC permitting program implements the Title V Federal Operating Permit program, as well as the minor source permitting program for facilities that emit less than 100 tpy of all criteria pollutants and are not a major source of HAPs. The Goldstrike Mine's current operations are regulated by air quality operating permit AP1041-0739.01.

Under its broad statutory authority to regulate air pollution, BAPC also has implemented a mercury control program that applies to all emission units located at precious metals mines that use direct or indirect thermal energy. This program is unique to the state of Nevada and is codified at NAC 445B.3611 to NAC 445B.3689. The program's goal is to ensure that all non-de minimis thermal emission units are controlled to provide the maximum degree of reduction of mercury emissions in accordance with factors enumerated in the rule.

3.11.2.2 No Action Alternative

Under the No Action Alternative, the proposed Betze Pit Expansion Project would not be developed, and the associated air quality impacts would not occur. However, under this alternative, the existing Goldstrike Mine would continue to operate under current authorizations.

An analysis of potential air quality impacts associated with the existing operation was presented in the Betze Project EIS (BLM 1991a,b), and updates are addressed in the recent air permit application submitted to NDEP (BGMI 2007g). Based on these analyses, the modeled concentrations of criteria pollutants are a fraction of the applicable ambient air quality standards.

The Goldstrike Mine currently operates under Class I Air Quality Operating Permit No. 1041-0739.01, issued by NDEP. Emissions from mining include criteria air pollutants such as PM_{10}, gaseous emissions (nitrogen oxides [NO_X], SO_2, and CO), and metal HAPs such as mercury. Background emission sources include traffic on unpaved roads, windblown dust, agricultural activities, and emissions from existing and future power generation facilities. The Goldstrike operations are a source of gaseous air pollutants including SO_2, CO, NO_x, and volatile organic compounds (VOCs). The Goldstrike Mine is a major source (potential to emit greater than 100 tpy) of PM_{10}, NO_x, SO_2, and CO.

These permits establish air emission levels to meet air quality standards that are protective of human health and the environment. Air quality in the vicinity of the proposed expansion would continue to be better than the NAAQS. Project emissions associated with the proposed expansion would not adversely affect air quality or visibility in any Class I areas.

Trace metal emissions are generated from the mine and processing facilities. Air pollution control technology and work practices are employed in the processing facilities and operations having the potential to generate air emissions. Fugitive dust emissions are controlled using best practical methods as specified in the applicable fugitive dust control plan. Emissions from process sources are controlled in accordance with the requirements of the air quality operating permit issued by the Nevada BAPC. Such requirements include compliance with specified operating and emission limitations and the operation of emission control systems. Additionally, mercury emissions from process sources are controlled in accordance with Nevada's voluntary and regulatory Mercury Control Programs, which require testing, monitoring, recordkeeping, reporting, and the installation and operation of state-of-the-art controls.

CO_2 Emissions

Combustion of biomass and all fossil fuels (coal, petroleum, and natural gas) result in emissions of carbon dioxide (CO_2), a greenhouse gas (GHG). Mining operations at the Goldstrike Mine involve combustion of coal, diesel, propane, and gasoline, all of which contribute relatively small amounts of CO_2 to the atmosphere. In Nevada, the total CO_2 emissions from all combustion sources are approximately 48 million metric tons. Industrial sources account for approximately 2.5 million metric tons and, thus, represent approximately 4 percent of the state's emissions of CO_2. Since mining is only a fraction of the total industrial sources within

the state, and Goldstrike is one of many mines, it is clear that combustion sources at the Goldstrike Mine represent a small fraction (much less than 1 percent) of the total CO_2 emissions from sources within Nevada. Additional information regarding GHG emissions and estimated fuel and electrical power consumption for the alternatives is presented in section 3.15, Energy Requirements.

Mercury Emissions

Table 3.11-4 describes the Toxic Release Inventory (TRI) for mercury from 1998 through 2006. **Table 3.11-5** summarizes the unit-specific annual mercury emissions reported to BAPC by the Goldstrike Mine for 2006, and provides an estimate of the emissions of each species of mercury based on 2006 speciation testing conducted at the mine.

Under the Nevada Mercury Air Emissions Control Program (NMCP) Nevada Regulation 445B NAC, the Goldstrike Mine is required to equip mercury sources at the existing operation with the Nevada maximum achievable control technology (NvMACT). For Goldstrike mining operations, the Nevada BAPC requires that the technologies to control mercury emissions listed in **Table 3.11-6** be operated until such time as additional or different controls are required by NvMACT.

As described in the No Action Alternative (Chapter 2.0), BGMI transports all ore generated from Goldstrike Mine operations to the existing ore processing facility. BGMI has developed a detailed air toxics inventory for this facility using stack test results, emissions factors, actual processing rates, and hours of operation to estimate actual mercury emissions. Based on BGMI's TRI, total airborne process emissions of mercury from the mine were estimated to be 617 pounds in 2006 (NDEP 2006).

Mercury is included on the federal list of HAPs, which has been adopted by reference in the Nevada air quality regulations. Nevada air quality regulations (NAC 445B.349) prohibit the *"discharge into the atmosphere from any stationary source of any hazardous air pollutant or toxic regulated air pollutant that threatens the health and safety of the general public, as determined by the director."* The USEPA has not established a National Emission Standard for Hazardous Air Pollutants for mercury emissions from gold ore processing facilities. Mercury is not considered a primary pollutant, and no NAAQS have been established under the CAA for mercury.

Mercury Deposition

Relative contributions of mercury deposition from Nevada gold mining operations and other local, regional, and global sources to watersheds located in Nevada are based on USEPA computer simulation modeling using the Regional Modeling System for Aerosols and Deposition (REMSAD). REMSAD results are used to quantify contributions of specific sources and source categories to mercury deposition within each of the lower 48 states (USEPA 2006).

The REMSAD model is designed to calculate the concentrations of both inert and chemically reactive pollutants by simulating the physical and chemical processes in the atmosphere that affect the pollutants. The model is designed to simulate the chemical transfer of mercury mass from one form (particulate [Hg_p], divalent gaseous [Hg^2], and elemental [Hg^0]) to another. REMSAD simulates both wet and dry deposition of mercury. Wet deposition occurs as a result of precipitation scavenging. Dry deposition is calculated for each mercury species based on land use characteristics and meteorological parameters. REMSAD also includes re-emission of previously deposited mercury (originating from anthropogenic and natural sources) into the atmosphere from land and water surfaces.

The USEPA REMSAD modeling domain encompassed the continental U.S. and portions of Canada and Mexico, with a 12-km horizontal grid resolution over the entire U.S. portion of the domain. The model utilized 2001 meteorological data files with a 36-km horizontal resolution.

Table 3.11-4 Reported Annual Mercury Emissions for the Goldstrike Mine from the TRI and Nevada Mercury Control Program

TRI Facility Report Year	Mercury Emissions (lbs/year)
1998	1,515
1999	1,411
2000	1,514
2001	1,324
2002	1,299
2003	1,452
2004	2,205
2005	1,701
2006	617

Source: Environmental Management Associates, Inc. (EMA) 2006.

Table 3.11-5 Goldstrike Mine 2006 Reported Mercury Emissions and Speciation Estimates

Source Description	Hg^0 (lb/yr)	Hg^2 (lb/yr)	Hg_p (lb/yr)	Total Hg (lb/yr)
Autoclave 1	9.9	0.5	0.2	10.7
Autoclaves 2 & 3	19.6	6.5	1.9	28
Autoclave 4	11.3	1.2	2.0	14.5
Autoclaves 5 & 6	20.5	8.3	2.1	30.8
Roasters 1 & 2	211.0	22.2	0.8	234.1
Retort 1	0.7	0.4	0.0	1.13
Retort 2	1.1	0.0	0.0	1.13
Retort 3	0.5	0.4	0.2	1.13
Mill Furnaces & Electrowinning Cells	9.1	0.1	0.0	9.2
Electrowinning Cells only	20.4	0.2	0.3	20.8
Carbon Kiln	244.0	3.8	0.4	248.3
Lab Assay Furnaces	7.0	5.2	4.1	16.3
De Minimis Lab Equipment	0.3	0.2	0.2	0.66
Facility Total	**555.4**	**49.0**	**12.2**	**616.8**

Note: Hg^0 is elemental, Hg^2 is reactive/oxidized, Hg_p is particulate.

Source: NDEP 2006.

Table 3.11-6 Mercury Controls on Thermal Processes at the Goldstrike Mine

Autoclave 1	Wet venturi scrubbers
Autoclaves 2 & 3	Wet venturi scrubbers
Autoclave 4	Wet venturi scrubbers
Autoclaves 5 & 6	Wet venturi scrubbers
Roasters 1 & 2	Gas quenching, wet gas condenser, wet electrostatic precipitator, mercury adsorption tower
Retort 1, 2, and 3	Mercury condensers and scrubbers with carbon filtration canisters
Mill Furnaces & Electrowinning Cells	Cyclone and baghouse, sulfur-impregnated carbon filtration scrubber unit
Electrowinning Cells only	Sulfur-impregnated carbon filtration scrubber unit
Carbon Kiln	Wet venturi scrubber, sulfur-impregnated carbon filtration unit

Source: BGMI 2007a.

The AggreGATOR program was developed as a tool for overlaying the model output grid from the USEPA REMSAD modeling to any polygon of interest (e.g., a hydrologic boundary or state boundary). The AggreGATOR program allows the results from the USEPA REMSAD modeling to be analyzed in a customized fashion to assess mercury deposition contributions from specific sources and categories of sources at specified areas, such as watersheds, within the model domain. This analysis is based on the 2007 versions of the USEPA REMSAD modeling and AggreGATOR program. The combination of these two data tools provides the best information currently available for modeled mercury deposition rates to watersheds in this region.

The AggreGATOR program incorporates the REMSAD 12-km grid cell output data and aggregates this data so that it can be viewed for an entire watershed or state. The watersheds defined by the AggreGATOR for Nevada typically include 30 to 60 REMSAD grid cells. The AggreGATOR program allows the user to specify:

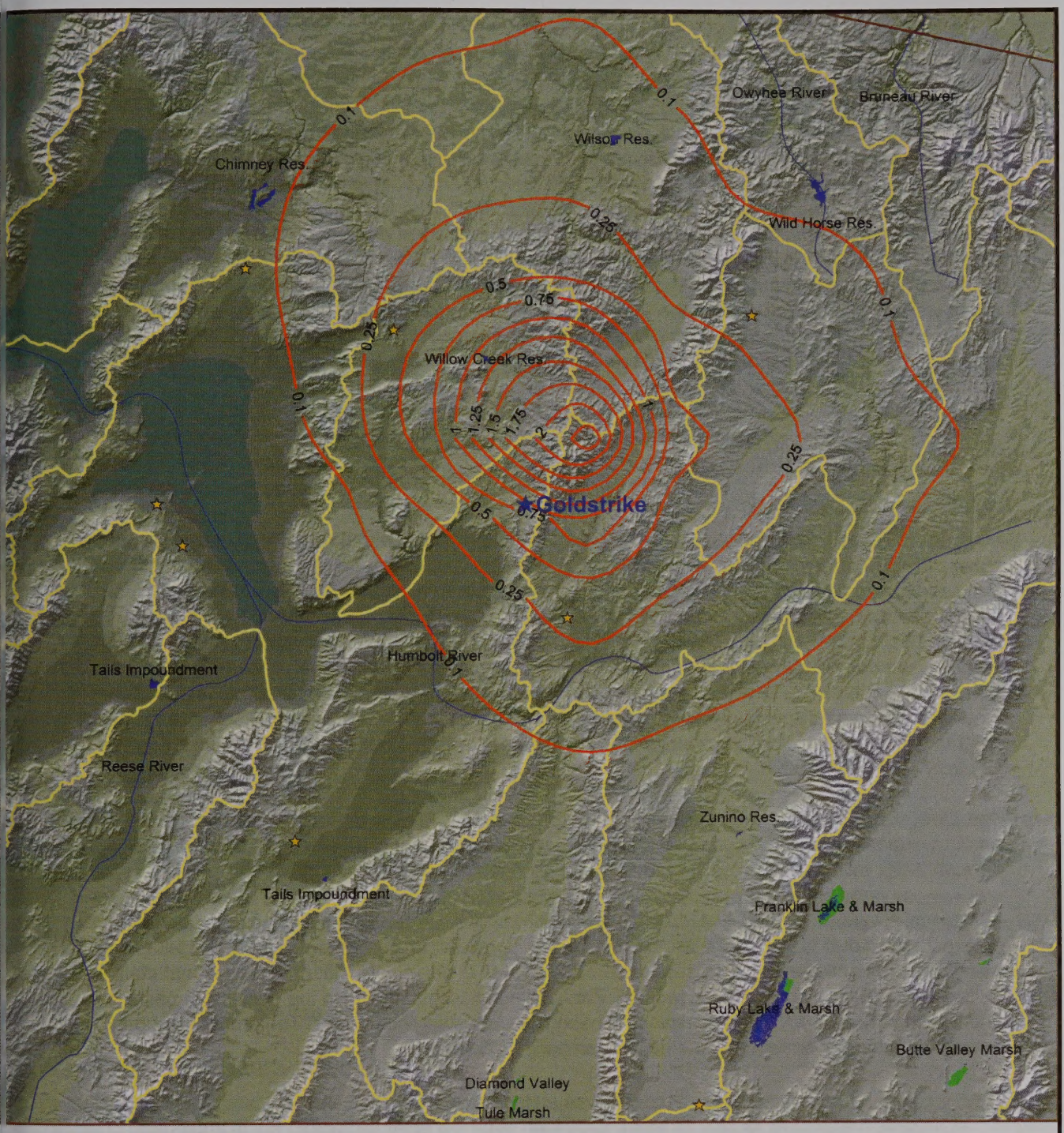
1. The target area (watershed, group of watersheds, entire state, etc.);

2. The source or group of sources for the denominator (usually all the sources including global background are selected); and

3. The source or group of sources for the numerator.

The AggreGATOR program calculates the relative percentage of deposition from the source(s) selected for the numerator to the deposition from the source(s) selected for the denominator within the target area. The USEPA REMSAD modeling and AggreGATOR program results on mercury deposition from Goldstrike Mine operations were presented in Lewis (2007, 2008) and are summarized below.

Database tables within the USEPA AggreGATOR model were accessed to obtain numerical values of Hg deposition based on a 12-km grid cells from the REMSAD model. These data were then analyzed to show isopleths of the annual deposition rates of mercury from Goldstrike's mercury emissions. These isopleths are provided in **Figure 3.11.3**, along with local water bodies, marshes, and major rivers. The maximum deposition from the Goldstrike Mine occurs at the 12-km grid cell immediately northeast of the grid cell containing the Goldstrike Mine (**Figure 3.11-3**). This may be the result of how the model handles plume rise. The plume appears to be carried by winds from the southwest to the next (northeast) grid cell before the model distributes the mercury concentration from the plume across this grid cell (Lewis 2008). **Figure 3.11-3** shows mercury deposition rates decreasing to 0.1 g/km^2-yr at a distance of 30 to 100 km. The statewide average global



Legend

- Goldstrike Mine
- Other Gold Mines
- Hg Deposition (g/km g/km^2/yr)
- Lakes, Reservoirs, and Major Rivers
- Wetlands and Marshes

Source: Lewis 2008.

Note: Nevada state-wide global background average deposition is 11.1 g/km2-yr.

N

0 25,000 50,000 Meters

Betze Pit Expansion Project

Figure 3.11-3

Mercury Deposition from the Goldstrike Mine

background deposition is 11.1 g/km^2-yr as used by the AggreGATOR program, so 0.1 g/km^2-yr represents about 1 percent of the global background deposition.

The USEPA REMSAD modeling analyzed all three forms of mercury. The total mercury emissions modeled for the Goldstrike Mine (588 pounds) consisted of 90 percent Hg^0 and 10 percent Hg^2 and Hg_p. These percentages are consistent with Goldstrike's 2006 mercury emissions profile. Emissions of Hg^2 and Hg_p are the primary contributors to near-field deposition (Lewis 2008). The fraction of the total mercury emissions does not contribute significantly to near-field mercury deposition.

The Goldstrike Mine's contribution to the mercury deposition in the Willow Creek Reservoir region, approximately 32 km northwest of the Goldstrike Mine, is approximately 1.0 to 1.25 g/km^2-yr, or about 10 percent of the total deposition according to the USEPA model (**Figure 3.11-3**). The Wildhorse Reservoir area, approximately 90 km northeast of the Goldstrike Mine, receives less than 0.1 g/km^2-year of mercury deposition from the mine, or less than 0.8 percent of the total deposition.

3.11.2.3 Proposed Action

Criteria Pollutant Emissions

Gaseous pollutant emissions associated with the Proposed Action would result from blasting, construction and mining equipment, and vehicle exhaust. These emissions would be minimized by proper equipment maintenance and operation. BGMI would obtain required air quality construction and operating permits from the Nevada BAPC.

Fugitive dust emissions would be generated by expansion of the pit, construction of a waste rock facility and tailings facility, including in-pit and perimeter haul roads and access roads, mining, processing, hauling, stockpiling ore, and disposal of waste rock. Particulate emissions would be mitigated by minimization of drop heights during loading, dust suppression, and procedures outlined in the Barrick Goldstrike Fugitive Dust Control Plan (BGMI 2007h).

The proposed expansion would utilize the existing primary facilities, including ore processing facilities and ancillary support facilities. If approved, the anticipated mine life would be extended approximately 4 years through 2015, followed by an estimated 16 years for ongoing ore processing.

The proposed expansion would extend the operations of the roaster facility by 5 years at its design rate. The pit expansion would not increase the existing levels of production, design capacity, or emission limits, and therefore is not anticipated to increase the emission rates of particulate matter, gaseous materials, or trace metals associated with mineral processing. Particulate emissions comprise the principal impacts to air quality and are primarily associated with mining, transport, and crushing operations. The proposed expansion would extend the period of emissions from mine operations by 5 years.

Mercury Emissions

Ore from the expansion project would be processed at BGMI's existing processing facility, which will continue to operate at existing levels of production, design capacity, etc. Mercury levels in the ore from the expansion project are about the same or less than levels in the previously mined areas. The levels range from about 1 ppm to 5 ppm in the expansion area and from 1 ppm to 10 ppm in the previously authorized mine areas (BGMI 2008a). Based on the 12.4 million tons of ore from the proposed laybacks and similarity in mercury content of the ore from previously mined areas, an estimated total emissions of 625 pounds of mercury would result from 5 years of mineral processing. Therefore, it is not anticipated to increase mercury emission rates. Although emissions will extend over a longer period of time, based on the implementation schedule of the NMCP, process mercury emissions are expected to decrease over that period.

Maximum potential hourly emissions would not increase due to processing of ore, and there would be no projected increases in total annual mercury emissions from the facility. The Proposed Action would result in an extension of operations from the roaster by 5 years with corresponding extension of emissions by 5 years.

HAPs

No individual HAP (including mercury) would be emitted in a quantity greater than the major source limit of 10 tpy, and the combination of HAP emissions would be less than the major source limit of 25 tpy. Therefore, the proposed project would not constitute a major HAP source. The 2006 inventory of HAP emissions for the Goldstrike Mine is listed in **Table 3.11-7**.

3.11.2.4 Bazza Waste Rock Facility Alternative

Under this alternative, the existing Bazza Waste Rock Facility would be expanded vertically and the Clydesdale Waste Rock Facility and haul road would not be constructed. Placement of waste rock in the Bazza facility would result in increased haul distances. All other project facilities would be the same as described under the Proposed Action.

Potential air quality impacts under this alternative would be the same as described for under the Proposed Action with the following exception. The Bazza Waste Rock Facility Alternative would result in additional fugitive dust and haul truck combustion emissions compared to the Proposed Action as a result of the greater haul distance under this alternative. The average total round trip for a haul truck from the Betze Pit to the Bazza Waste Rock Facility is approximately 1.3 miles longer than the roundtrip haul distance from the pit to the proposed Clydesdale Waste Rock Facility. This alternative would result in an additional 58,850 haul truck operating hours and combustion of an additional 5.3 million gallons of fuel over the life of the project, resulting in additional emissions of CO, SO_2, NO_2, carbon, and other compounds.

3.11.3 Cumulative Impacts

The CESA for air resources is shown in **Figure 3.11-1**. Past and present actions and RFFAs are identified in Section 3.1.

Cumulative impacts to air quality would include impacts from the proposed project emission sources in combination with impacts from background emission sources, which reflect emissions associated with the past and present actions, as well as proposed future actions.

3.11.3.1 No Action Alternative

Fugitive Dust and Gaseous Emissions

Fugitive dust and gaseous emissions from nearby mine operations affect air quality in the project area. The existing operations at the Goldstrike Mine will have haul truck traffic as well as extended operation of processing facilities as currently authorized. Ambient air quality data for the region currently reflects impacts of existing mining operations in the airshed. Air quality in the region meets applicable standards and would be expected to remain in compliance under existing Goldstrike operations. Approximately 928 pounds of mercury and mercury compounds were reportedly released annually to the air by mining operations in the Carlin Trend (NDEP 2006). An air quality modeling analysis was conducted for the Leeville SEIS (BLM 2007b) to study potential cumulative effects for other active projects in the region. A summary of the sources of emissions that were included in the modeling are presented in **Table 3.11-8**. The modeling analysis confirmed that there would be no impact to the nearest Class I area, Jarbidge Wilderness.

Table 3.11-7 HAP Emissions for the Goldstrike Mine

Pollutant	Total Emissions (tpy)[1]
Arsenic	0.16
Beryllium	0.00
Cadmium	0.01
Cobalt	0.00
Chromium	0.03
Mercury	0.31
Manganese	0.08
Nickel	0.02
Phosphorous	0.00
Lead	0.04
Antimony	0.00
Selenium	0.02
VOC HAPs	
1,3-Butadiene	0.02
2,4-Dinitrotoluene	0.00
2-Chloroacetophenone	0.00
Acetaldehyde	0.23
Acetophenone	0.00
Acrolein	0.01
Benzene	2.24
Benzyl chloride	0.03
Biphenyl	0.00
Bis(2-ethylhexyl)phthalate	0.00
Bromoform	0.00
Carbon disulfide	0.01
Chlorobenzene	0.00
Chloroform	0.00
Cumene	0.00
Dimethyl sulfate	0.00
Dioxins	0.00
Ethyl benzene	0.08
Ethyl chloride	0.00
Ethylene dibromide	0.00
Ethylene dichloride	0.00
Ethylene glycol	0.00
Formaldehyde	0.07
Hexane	1.57
Isophorone	0.02
Methyl bromide	0.01
Methyl chloride	0.02
Methyl chloroform	0.00
Methyl ethyl ketone	0.02
Methyl hydrazine	0.01
Methyl isobutyl ketone	0.00
Methyl methacrylate	0.00
Methyl tert butyl ether	0.87
Methylene chloride (Dichloromethane)	0.01
Naphthalene	0.04
Phenol	0.00
POM	0.00
Propionaldehyde	0.02
Styrene	0.00
Tetrachloroethylene	0.00
Toluene	0.62
Vinyl acetate	0.00
Xylenes (mixture)	0.38
Non-Metallic Inorganic HAPs	
Hydrogen cyanide	0.95
Hydrochloric acid	0.03
Hydrogen fluoride	0.00
Cyanide compounds (excluding HCN)	0.00
Chlorine	0.01
Total HAP[2] Emissions	7.96

[1]tpy = tons per year.

[2]HAP = Hazardous air pollutants.

Source: BGMI 2007a.

Table 3.11-8 Summary of Emission Sources Included in Leeville Air Quality Modeling

Facility	Number of Model Sources	Emissions of PM_{10} (t/y)	Emissions of CO (t/y)	Emissions of NO_x (t/y)	Emissions of SO_2 (t/y)
SOAPA	84	568	337	354	276
Leeville	7	0.5	0	0	0
North Operations Area without Leeville	40	93.8	0	0	0
Goldstrike	179	579	400	311	996
TS Power Plant	28	598	744	1,170	1,546
Total	**338**	**1,840**	**1,480**	**1,835**	**2,818**

Source: EMA 2006.

According to the cumulative air quality analysis performed for the Leeville SEIS, modeling of emission sources at the Goldstrike Mine predicted maximum cumulative annual PM_{10} effects of 10.62 $\mu g/m^3$ and maximum 24-hour PM_{10} impacts of 16.65 $\mu g/m^3$. Predicted PM_{10} impacts represent 21 percent of the annual Nevada PM_{10} ambient air quality standard of 50 $\mu g/m^3$ and 11 percent of the 24-hour PM_{10} ambient air quality standard of 150 $\mu g/m^3$. Predicted air quality impacts from the Goldstrike Mine indicate that cumulative PM_{10} air impacts would be below applicable criteria in the CESA.

The air quality dispersion modeling study for Goldstrike operations included predicted impacts of gaseous criteria air pollutants SO_2, NO_2, and CO. This modeling was completed in 2006 (EMA 2006). The dispersion modeling analysis predicted the following maximum cumulative effects:

- 3-hour SO_2: 13.03 $\mu g/m^3$ (ambient air quality standard = 1,300 $\mu g/m^3$)
- 24-hour SO_2: 2.94 $\mu g/m^3$ (ambient air quality standard = 365 $\mu g/m^3$)
- Annual SO_2: 0.4 $\mu g/m^3$ (ambient air quality standard = 80 $\mu g/m^3$)
- Annual NO_2: 0.83 $\mu g/m^3$ (ambient air quality standard = 100 $\mu g/m^3$)
- 1-hour CO: 216.49 $\mu g/m^3$ (ambient air quality standard = 40,000 $\mu g/m^3$)
- 8-hour CO: 38.25 $\mu g/m^3$ (ambient air quality standard = 10,000 $\mu g/m^3$)

Background concentrations were not added to these impacts in the analysis, in part because the impacts were low and due to the lack of gaseous air pollutant monitoring data. By applying the ambient air quality standard as significance criteria, it is reasonable to assume that the predicted SO_2, NO_2, and CO air quality impacts from the Goldstrike operations dispersion modeling demonstrate no significant effects in the CESA (BLM 2007b).

Mercury

Mercury deposition rate data have been collected from two wet deposition monitoring sites in northern Nevada that are part of a national Mercury Deposition Network. These sites are outside of the study area, but they are the nearest source of cumulative mercury monitoring data. The monitoring data presented here (**Table 3.11-9**), represent cumulative effects from a wider area of influence than the study area, but the data are believed to be

Table 3.11-9 Cumulative Mercury Monitoring Data

Sampling Site	Annual Total Mercury Wet Deposition (g/km^2)	
	2003	2005
Lesperance Ranch NV02	30	26
Gibbs Ranch NV99	43	40

representative of the trend in environmental impacts from atmospheric releases of mercury involving sources in the study area. The Lesperance Ranch site (NV02) is located approximately 85 miles northwest of the study area, and the Gibbs Ranch site (NV99) is located approximately 73 miles northeast of the study area. These sites began collecting mercury wet deposition data in early 2003, and data are available through 2005. Measured wet deposition for the Mercury Deposition Network sites in northeastern Nevada decreased slightly from 2003 to 2005. Mercury wet deposition at the Lesperance Ranch site decreased by 11 percent from an annual total mercury wet deposition of 30 grams per square kilometer (g/km^2) in 2003 to 26 g/km^2 in 2005. At the Gibbs Ranch monitoring site, annual mercury wet deposition decreased by 7 percent from a value of 43 g/km^2 in 2003 to 40 g/km^2 in 2005. Mercury wet deposition decreased from 2003 to 2004, despite a 107 percent increase in precipitation.

According to Lewis (2007), the global background is by far the largest contributor to the state-wide deposition for the USEPA Region 9 states: California, Nevada, and Arizona. The global background contribution percentages for these states as calculated by the AggreGATOR program are provided in **Table 3.11-10**.

Table 3.11-10 State-Wide Global Background Deposition

State	Global Hg Deposition Contribution	Global Hg Deposition (g/km^2)
California	82.3%	11.1
Nevada	92.5%	11.1
Arizona	92.4%	15.4

Source: Lewis 2007.

The results from the USEPA REMSAD modeling and AggreGATOR program provide an estimate of the mercury deposition impacts from the Nevada gold mines and global background to Nevada watersheds. **Table 3.11-11** summarizes these impacts for the watersheds on the Nevada-Idaho and Nevada-Utah borders.

The mercury deposition impacts from the Nevada gold mines at the watersheds bordering Nevada with Idaho and Utah are between 0.06 and 6.35 percent of the total impact. The mercury deposition impacts from the Goldstrike Mine range from 0.01 to 2.47 percent at watersheds bordering Nevada with Idaho and Utah.

Figure 3.11-4 provides the mercury deposition contributions from the Goldstrike Mine's mercury emissions as a percentage of the total deposition (including global background) for each watershed in Nevada. The mercury deposition from the Goldstrike Mine drops off to less than 1 percent at two watersheds distance from the mine, indicating that the deposition of mercury from mines occurs locally.

Table 3.11-11 Mercury Deposition on Border Watersheds

Watershed	Goldstrike Mine Hg Deposition Contribution	All Nevada Gold Mines Hg Deposition Contribution	Global Background Hg Deposition Contribution
Nevada-Idaho (from west to east)			
East Little Owyhee	0.72%	3.25%	92.69%
South Fork Owyhee	2.47%	6.35%	89.69%
Upper Owyhee	0.58%	5.80%	90.04%
Bruneau	0.46%	2.77%	93.05%
Salmon Falls Creek	0.36%	1.62%	94.11%
Goose Creek	0.17%	0.76%	93.38%
Nevada-Utah (from north to south)			
N. Great Salt Lake Desert	0.12%	0.51%	80.91%
S. Great Salt Lake Desert	0.12%	0.56%	92.95%
Hamlin-Snake Valleys	0.05%	0.27%	94.74%
Escalante Desert	0.01%	0.07%	94.26%
Lower Virgin	0.01%	0.06%	92.78%

Source: Lewis 2007.

Figure 3.11-5 provides the mercury deposition contributions from the global background to each watershed in Nevada. The global background accounts for 66 to 97 percent of the total deposition in each watershed.

3.11.3.2 Proposed Action

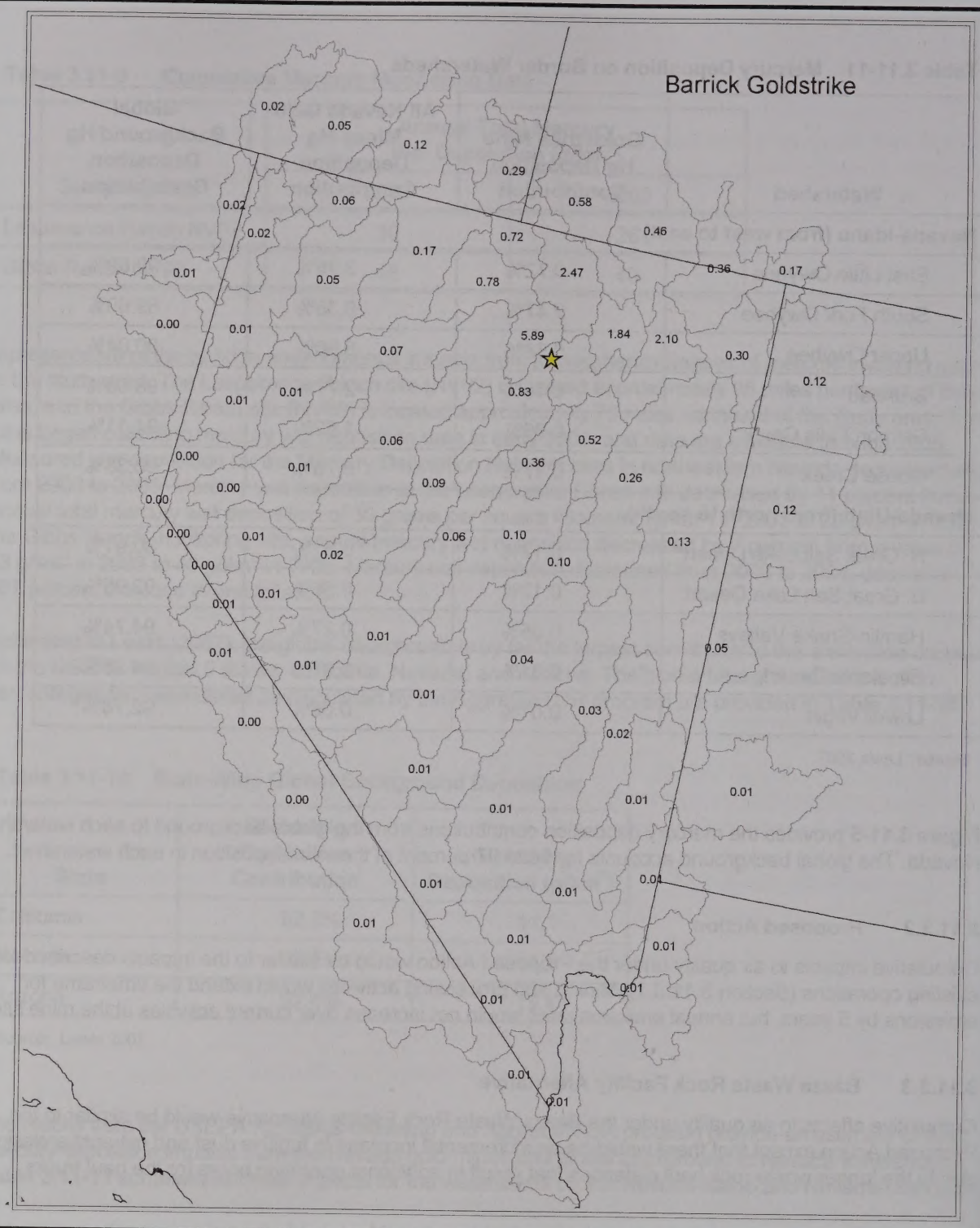
Cumulative impacts to air quality under the Proposed Action would be similar to the impacts described for existing operations (Section 3.11.3.1). Mining and processing activities would extend the timeframe for emissions by 5 years, but annual emission rates would not increase over current activities at the mine site.

3.11.3.3 Bazza Waste Rock Facility Alternative

Cumulative effects to air quality under the Bazza Waste Rock Facility Alternative would be similar to the Proposed Action except that there would be an incremental increase in fugitive dust and exhaust emissions due to the longer waste rock haul distances that result in additional operating hours for the haul trucks.

3.11.3.4 Mitigation Measures and Monitoring

Air quality emission sources at the Goldstrike Mine would be subject to requirements of federal and Nevada air quality regulations. NDEP Bureau of Air Quality would determine whether air quality construction and operating permits would be required for the proposed action. The air quality permitting process could require that BGMI submit a permit application, including a complete inventory of potential criteria air pollutant emissions from the proposed action. No additional monitoring or mitigation measures have been identified, as no significant impacts to air quality would be anticipated as a result of the proposed action.



LEGEND

☆ Location of Goldstrike Mine

N

Source: Lewis 2007.

Betze Pit Expansion Project

Figure 3.11-4

Goldstrike Mine's Mercury Deposition Contributions as a Percent of Total

08/05/08



LEGEND

★ Location of Nevada Mines

N

Source: Lewis, 2007.

Betze Pit Expansion Project

Figure 3.11-5

Global Background Mercury Deposition Contributions as a Percent of Total

8/05/08

3.11.4 Residual Impacts

There would be no residual adverse impacts to air quality from the proposed action or alternatives because reclamation and revegetation would stabilize exposed soil and control fugitive dust emissions. As vegetation becomes established, particulate levels should return to typical conditions of a dry desert environment. Once the disturbance ceases and wind erodible surfaces are reclaimed, the resource would return to approximately its pre-mining condition.

3.12 Social and Economic Values

3.12.1 Affected Environment

The social and economic values study area for direct and indirect impacts and the CESA includes Elko County and Eureka County with particular focus on the communities of Elko, Carlin, and Spring Creek (**Figure 3.12-1**). The Goldstrike Mine is located in Elko and Eureka counties and generates public revenue for both counties, a substantial majority of the workers, over 95 percent, live in west-central Elko County. Approximately 56 percent live in the City of Elko and vicinity, 32 percent in or near Spring Creek, and 7 percent live in Carlin. Approximately 3 percent of the workers are scattered throughout Nevada, including less than 0.5 percent in Eureka County; and slightly fewer than 2 percent claim primary residences distributed among 8 other nearby states.

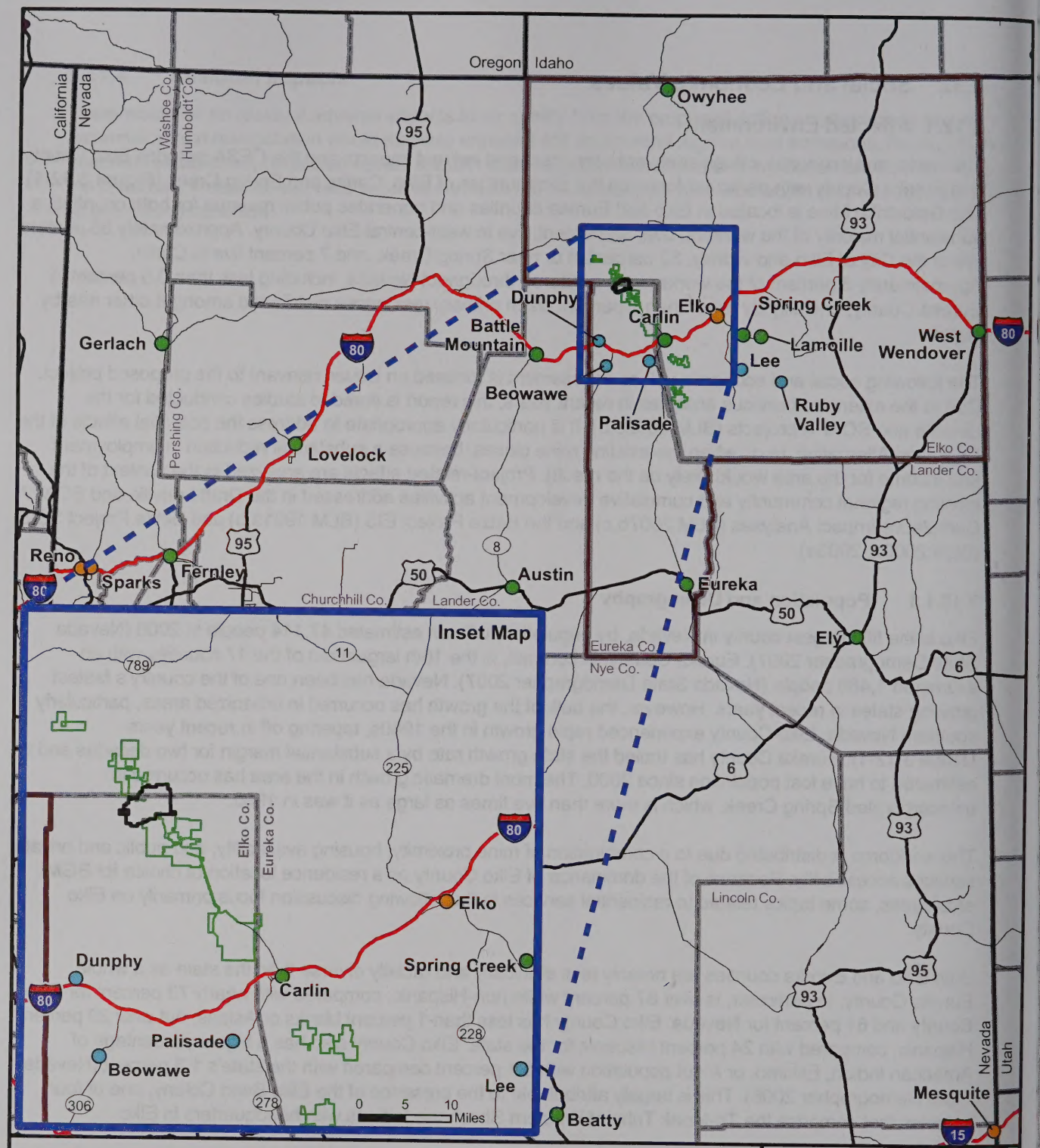
The following social and economic values assessment is focused on issues relevant to the proposed project. Due to the extensive previous analyses in recent years, this report is tiered to studies conducted for the Leeville and SOAPA projects (BLM 2002a,b). It is particularly appropriate to address the potential effects of the No Action Alternative, (e.g., when the existing mine closes, because a substantial reduction in employment and income for the area would likely be the result). Project-related effects are analyzed in the context of the existing regional community and cumulative development activities addressed in the Draft Leeville and SOAPA Cumulative Impact Analyses (BLM 2007b,c) and the Betze Project EIS (BLM 1991a,b) and Betze Project SEIS (BLM 2000a, 2003a).

3.12.1.1 Population and Demography

Elko is the fifth largest county in Nevada, by population, with an estimated 47,114 people in 2006 (Nevada State Demographer 2007). Eureka County, in contrast, is the 16th largest out of the 17 counties with an estimated 1,480 people (Nevada State Demographer 2007). Nevada has been one of the country's fastest growing states in recent years. However, the bulk of the growth has occurred in urbanized areas, particularly southern Nevada. Elko County experienced rapid growth in the 1980s, tapering off in recent years **(Table 3.12-1)**. Eureka County has trailed the state growth rate by a substantial margin for two decades and is estimated to have lost population since 2000. The most dramatic growth in the area has occurred in unincorporated Spring Creek, which is more than five times as large as it was in 1980.

The workforce is distributed due to a combination of mine proximity, housing availability, and public and private services accessibility. Because of the dominance of Elko County as a residence location of choice for BGMI employees, some topics related to residential services in the following discussion focus primarily on Elko County.

Both Elko and Eureka counties are notably less ethnically and racially diverse than the state as a whole. Eureka County, in particular, is over 87 percent white non-Hispanic, compared with nearly 73 percent for Elko County and 61 percent for Nevada. Elko County has less than 1 percent blacks or Asians, but over 20 percent Hispanic, compared with 24 percent Hispanic for the state. Elko County also has a higher percentage of American Indian, Eskimo, or Aleut population with 5.1 percent compared with the state's 1.3 percent (Nevada State Demographer 2006). This is largely attributable to the presence of the Elko Band Colony, one of four colonies that comprise the Te-Moak Tribe of Western Shoshone Indians with headquarters in Elko.


Oregon
Idaho
California
Nevada
Washoe Co.
Humboldt Co.
Owyhee
95
93
80
Dunphy
Carlin
Elko
Spring Creek
Battle Mountain
Gerlach
Lamoille
West Wendover
Lee
Beowawe
Palisade
Ruby Valley
Pershing Co.
Lovelock
Elko Co.
Lander Co.
Reno
Sparks
Fernley
8
Austin
Eureka
Churchhill Co.
Lander Co.
50
Eureka Co.
Nye Co.
Ely
6
Inset Map
789
11
225
Elko Co.
Eureka Co.
Lincoln Co.
Elko
Spring Creek
Dunphy
Carlin
Palisade
228
Beowawe
306
278
Lee
0 5 10 Miles
Beatty
Nevada
Utah
Mesquite
15
LEGEND
Goldstrike Mine Operations Boundary
Social and Economic Values Cumulative Effects Study Area
Mine Plan Boundaries
Highway
Road
County Boundary
City
Community
Rural Post Office
N
0 5 10 20 Miles
Source: BLM 2007a,b.
Betze Pit Expansion Project
Figure 3.12-1
Social and Economic Values CESA

07/24/2008

Table 3.12-1 Population Characteristics

Area	1980	1990	2000	2006	Annual % Change 1980-1990	Annual % Change 1990-2000	Annual % Change 2000-2006
Elko City	8,771	14,736	16,708	18,183	5.3	1.3	1.4
Spring Creek CDP[1]	2,002	5,866	10,548	n.a.	11.3	6.0	–
Carlin	1,233	2,220	2,161	2,281	6.1	(0.3)	0.9
Elko County	17,269	33,530	45,291	47,114	6.9	3.1	0.7
Eureka County	1,198	1,550	1,651	1,480	2.6	0.6	(1.1)
Nevada	800,493	1,201,833	1,998,257	2,623,050	4.1	5.2	4.6

[1]Census Designated Place.

Sources: Nevada State Demographer 2007; U.S. Census Bureau 2000.

3.12.1.2 Income

Mining wages and salaries are among the highest for any industry in Nevada. Median annual wages for all workers in the natural resources and mining industries in Elko County were $47,289 (without overtime) (Nevada Department of Employment, Training & Rehabilitation [NDETR] 2007). This is substantially higher than the median for workers in all industries in Elko County combined, which was $27,164. Eureka County's wage levels are not available disaggregated by industry because of the relatively small total workforce and the dominance of the mining industry in the county's economy.

Although mining wages and salaries are typically higher than average, per capita personal income (PCPI) in the study area continues to lag behind the state level; data from 2000 indicated a state income average of $30,433. Elko County's income average was $24,608 (80.1 percent of the state level), and Eureka County's income average was $23,299 (76.6 percent of the state level). By 2005, Elko County PCPI had risen to $30,127, which was an improvement to 84.3 percent of the state average of $35,744 and 87.4 percent of the national average of $34,471. Eureka County's PCPI rose to $30,052 in 2005, 84.1 percent of the state average and 87.2 percent of the national average. Elko and Eureka counties' PCPI ranked 10th and 11th, respectively, out of 17 counties in the state.

In contrast, median household incomes in the study area are much closer to statewide household incomes. The median household income for the state for 2006 was $59,550, compared with $60,100 for Elko County (100.9 percent of the state level) and $57,500 for Eureka County (96.6 percent of the state level) (NDETR 2007).

An estimated 8.7 percent of Elko County's population and 9.0 percent of Eureka County's population were considered to be living in poverty in 2004 according to Census estimates (U.S. Census Bureau 2006). Both counties' estimates were lower than the statewide rate of 11.1 percent and the national estimate of 12.7 percent. The rates for children and youth under 18 living in poverty also were lower than state and national rates (U.S. Census Bureau 2006).

3.12.1.3 Economy and Employment

Elko and Eureka counties are major contributors to Nevada's mining industry. **Table 3.12-2** illustrates a comparison of the two counties' employment by major industry with statewide employment by the same

Table 3.12-2 Nonagricultural Wage and Salary Employment[1] by Sector

	State of Nevada		Elko County		Eureka County	
	Employees	%	Employees	%	Employees	%
Goods Producing - Private	**206,693**	**16.3**	**3,883**	**19.0**	**3,706**	**86.4**
Natural Resources & Mining	13,800	1.1	2,366	11.6	3,706	86.4
Construction	142,659	11.2	1,310	6.4	*	0.0
Manufacturing	50,234	4.0	208	1.0	*	0.0
Service Providing - Private	**916,705**	**72.1**	**12,893**	**63.0**	**100**	**2.3**
Trade, Trans., Warehouse & Util.	225,606	17.7	3,598	17.6	52	1.2
Information	15,129	1.2	191	0.9	*	0.0
Financial Activities	65,510	5.2	521	2.5	*	0.0
Prof. & Business Services	157,963	12.4	920	4.5	*	0.0
Educational & Health Services	87,282	6.9	1,095	5.3	*	0.0
Leisure & Hospitality	336,779	26.5	6,045	29.5	39	0.9
Other Services	28,436	2.2	523	2.6	9	0.2
Unclassified	**1,369**	**0.1**	**0**	**0.0**	**0**	**0.0**
Subtotal - Private	**1,124,767**	**88.5**	**16,776**	**81.9**	**4,096**	**95.5**
Service Providing - Public	**146,433**	**11.5**	**3,690**	**18.0**	**193**	**4.5**
Government	146,433	11.5	3,690	18.0	193	4.5
Subtotal - Public	**146,433**	11.5	**3,690**	**18.0**	**193**	**4.5**
TOTAL	**1,271,200**	100.0	**20,478**	**88.4**	**4,289**	**100.0**

[1]2006 Annual Averages.

* Confidential data, not released.

Source: NDETR 2007.

sectors. The employment numbers are based on work location not residence, which explains why Eureka County has more employees in the natural resources and mining sector than it has residents. Several major mines on the Carlin Trend, including Barrick's Goldstrike Mine, are located in Eureka County. Most workers live in Elko County, however, as noted above. The two counties account for 44 percent of all mining employment in Nevada. Over 86 percent of all employment in Eureka County is mining and natural resource related. Elko County, in contrast, has a substantial casino and hospitality industry and offers a variety of other services, which notably broadens its base of employment.

The Elko County School District is the largest single employer in the county with the next five largest employers all casinos. The top two and three of the top five largest employers in Eureka County are mining companies. BGMI is the second largest employer in Eureka County with slightly over 1,600 employees (NDETR 2007).

The combined labor force in the two counties is currently estimated at 27,400, approximately 26,400 of whom are employed. The remaining 1,000 unemployed individuals represent a 3.5 percent unemployment rate. This level is notably lower than both the 5.0 percent statewide unemployment rate and the national rate, estimated at approximately 4.5 percent (NDETR 2007).

3.12.1.4 Housing

The Census Bureau collected data for the 2000 census, and, although that data is now more than 7 years old, it is the most consistent available (U.S. Census Bureau 2000). The 2000 census found 18,456 housing units in Elko County and 1,025 units in Eureka County. At the time, 15,638 units were occupied in Elko and 2,818 (15.3 percent) were vacant. Some of the vacant units were seasonal, recreational, or for occasional use only. Vacancy rates were at a modest 3.2 percent in homeowner units, but a sizable 16.9 percent in rental units (U.S. Census Bureau 2000). Vacancy rates varied geographically as well as by type. The Spring Creek area had a 93 percent occupancy rate, while Elko was at 89 percent and Carlin was at 78 percent. Eureka County had 359 vacant housing units in 2000, which was 35 percent of the total 1,025 units. A moderate 5.4 percent of homeowner units were vacant, but a very substantial 37.9 percent of rental units were vacant (U.S. Census Bureau 2000).

The Census Bureau estimated that the number of housing units as of 2006 had increased to 19,239 in Elko County and 1,060 in Eureka County, which matches the population growth rate for Elko County, but raises questions for Eureka County because the population estimate showed a decline for that county.

The Nevada State Demographer also estimates housing units for use in developing annual population estimates, which, when certified, become the basis for revenue distributions throughout the state. Housing unit estimates for Elko and Eureka counties are based on assessors' records and utility data. The State Demographer's estimates for 2007 indicated that Elko County had 18,103 housing units, 16,915 (93.4 percent) of which were occupied and 1188 of which were vacant; and Eureka County had 887 housing units, 577 (65.1 percent) of which were occupied and 310 of which were vacant (Hardcastle 2007).

The estimated 6.6 percent vacancy rate in Elko County suggests a relatively healthy housing market in the county, likely based on the diversity in the county's economy and the relative stability in the mining industry in recent years.

The explanation for the discrepancy between the Demographer's estimates and the Census Bureau's estimates is uncertain, although at least a portion of the difference for Elko County is likely based on the fact that the State Demographer estimates the Native American population separately so their housing is not included in the totals. The City of Elko believes both estimates are too conservative, and has hired a statistician to evaluate the housing and population estimates (Barkdull Spencer 2008). The Elko County Economic Diversification Authority (ECEDA) also believes the Census and State Demographer estimates are low, based on their own study, which estimated there were more than 23,000 housing units in the county (Barkdull Spencer 2008). ECEDA contends there is considerable growth pressure occurring in the county from expansion in mining and casino industries and from the new Northeastern Nevada Regional Railport and Industrial Park. In response, there are 10 new subdivisions, 4 of which are under construction and 3 are scheduled for construction in the summer of 2008 (Barkdull Spencer 2008). Current activity is heaviest near West Wendover and between Elko and Spring Creek where new housing could fill the current gap between the two communities in the next few years (Barkdull Spencer 2008).

Elko is the primary location for short-term housing opportunities in the area, with at least 26 motels, hotels, and casinos hosting over 1,500 rooms. There also are numerous mobile home parks and recreational vehicle (RV) parks in the city and county.

3.12.1.5 Community Facilities and Services

Public Utilities

Water

The City of Elko obtains municipal water from 18 deep-water wells, with 25 million gallons of storage capacity. The system has a maximum production capacity of 14.5 million gallons per day (mgd) with current usage ranging from 3 mgd to a peak of 13 mgd. Spring Creek residents are served by nine public wells. Carlin obtains water from one deep-water well and several natural springs. Water is stored in a 2-million-gallon tank. Peak production capacity is 980 gpm, or approximately 1.4 mgd, averaging 450 gpm.

Wastewater

Elko and Carlin both have wastewater treatment facilities. Elko's is a "fixed film" biological treatment plant averaging 3.5 mgd. Approximately 60 percent of treated water is reused for irrigation. Carlin employs two lagoons with rapid infiltration basins. Wastewater treatment in Spring Creek utilizes private septic systems.

Solid Waste

The City of Elko operates a regional solid waste landfill. At current use rates, it has capacity in excess of 200 years.

Energy

Electricity is provided to study area residents by Sierra Pacific Power Company. Southwest Gas Corporation provides natural gas.

Public Safety

Law Enforcement

Law enforcement for unincorporated areas in Elko County is provided by the County Sheriff. Elko and Carlin police departments are responsible for incorporated jurisdictions. The Bureau of Indian Affairs Police are responsible for the 193-acre Elko Band Colony. The Eureka County Sheriff provides law enforcement for rural Eureka County. The Nevada Highway Patrol provides law enforcement on the state highway system.

Fire Protection

Fire protection services in the study area are provided by the City of Elko Fire Department, the Carlin City Volunteer Fire Department, the BLM, the USFS, and the Northeastern Fire Protection Department of the Nevada Division of Forestry. These departments are all involved in mutual aid/cooperative agreements. The Elko City Department is the largest of the agencies with 3 staff positions and 15 career firefighters supported by 34 volunteer positions. The department has 10 major pieces of equipment, including 7 regular engines, 2 smaller specialty trucks, and a specialized airport engine. The department also houses four pieces of Nevada Division of Forestry firefighting equipment. The Elko and Carlin fire departments primarily serve residents within their city limits and the Elko Band Colony. The BLM is primarily responsible for fighting wildland fires (BLM 2002).

Health Care

The Northeast Nevada Regional Hospital in Elko is the principal health care facility for all of northeastern Nevada. It provides 24–hour emergency care and has 75 acute care rooms. The hospital has a full service laboratory, an intensive care unit (ICU), both magnetic resonance imaging (MRI) and computerized axial

tomography (CAT) scan capabilities, and provides most major medical specialty services. The hospital also provides services to the Elko Band Colony Health Center under an Indian Health Service contract.

Education

Elementary and secondary schools in the study area are operated by the Elko County School District with administrative offices in Elko. The district serves the entire county and had a fiscal year (FY) 2007 enrollment of 9,907 pupils from pre-kindergarten through 12th grade on "count day" for a 0.8 percent increase over FY 2006.

Eleven of the district's schools are located in the Elko-Spring Creek-Carlin area. Elko has four elementary schools, one middle school, and one high school. Spring Creek has two elementary schools, a middle school and a high school. Carlin has a combined school for elementary through high school. The district has an overall ratio of 16.2 students per teacher.

Students from the Elko Band Colony attend Elko District schools. There also is a Head Start Program at the Colony for children from 3 to 5 years old.

Great Basin College provides higher education opportunities to residents in the study area. The college, a pioneer in distance learning techniques, serves nearly 4,000 students in six of Nevada's largest rural counties (Great Basin College [GBC] 2008). Its main campus, and only residential facility, is located in Elko. GBC also has a branch center with extensive course offerings in Battle Mountain and a satellite center with limited offerings in Carlin.

In addition to Great Basin College, the University of Nevada, Reno Fire Science Academy (FSA) is located at Carlin. The FSA is purported to be "one of the finest emergency response programs and training facilities in the world" (FSA 2008). It offers highly specialized training in emergency response and emergency management.

3.12.1.6 Public Finance

There are four main general governmental entities influencing the study area: Elko and Eureka counties, the City of Elko and the City of Carlin. Elko County has a professional county manager and a five-member Board of Commissioners, who oversee the operations of the county including administration, law enforcement, courts and public works. Eureka County operates with a three-member Board of Commissioners who function as both policy makers and administrators. Both the City of Elko and the City of Carlin employ council-manager governmental structures with professional city managers and policy making city councils each made up of a directly elected Mayor and four council members.

Local government finance in Nevada is a complex admixture of locally derived and state shared revenues. Local revenues are primarily *ad valorem* property taxes on real and personal property and the net proceeds of mines in the jurisdiction. State shared revenues include sales, motor vehicle, fuel and gaming taxes. State revenue sharing addresses significant economic disparities between the relatively wealthy urban centers of Reno and Las Vegas and the often less affluent rural agricultural and mining communities.

Both Elko County and Eureka County approved deficit budgets for FY 2006 to 2007, with plans to access ample reserves to cover the current revenue shortfalls if necessary **(Table 3.12-3)**. Elko County, in particular, chooses to budget conservatively by underestimating revenue for the forthcoming year and appropriating "every dime" for expenditures (Armuth 2008). The county's experience with this approach has been that, at the end of a fiscal year, actual revenue has exceeded their projections and expenditures for most funds rarely reach the appropriated levels (Armuth 2008). The result has been that the county's ending fund balance has grown consistently in recent years (Armuth 2008).

Table 3.12-3 County and City Budgets for Fiscal Year 2006-2007

	Governmental Fund Types and Expendable Trust Funds ($)			
	City of Elko	City of Carlin	Elko County	Eureka County
Revenues				
Property Taxes	2,805,738	250,000	7,808,869[1]	5,613,833
Other Taxes	2,513,232	64,500	14,000	110,500
Licenses and Permits	1,414,407	53,100	918,000	8,250
Intergovernmental Resources	12,267,317	1,509,328	18,165,592	4,943,536
Charges for Services	689,621	72,700	2,525,500	495,000
Fines and Forfeits	158,137	22,250	1,236,960	102,310
Miscellaneous	1,067,559	132,195	2,664,233	340,250
Total Revenues	**20,916,011**	**2,104,073**	**33,333,154**	**11,273,429**
Expenditures				
General Government	1,795,928	446,582	6,354,941	6,540,302
Judicial	240,500	55,427	8,566,111	1,164,550
Public Safety	8,527,841	566,627	9,699,293	2,021,184
Public Works	5,881,997	500,000	7,775,924	2,744,000
Sanitation	0	0	0	342,000
Health[2]	456,630	67,285	125,000	563,000
Welfare[2]			1,755,035	
Culture and Recreation	2,494,210	263,997	1,502,158	888,606
Community Support	28,000	47,315	569,325	737,900
Intergovernmental Expenditures	0	0	161,055	1,120,000
Capital Projects	0	0	0	0
Contingencies	0	0	440,000	200,000
Utility Enterprises	0	0	0	0
Hospitals	0	0	0	0
Transit Systems	0	0	0	0
Airports	0	0	0	0
Other Enterprises	0	0	0	0
Debt Service – Principal	353,107	26,564	1,119,888	0
Interest Cost	125,946	10,461	196,130	0
Total Expenditures	**19,904,159**	**1,984,258**	**38,264,860**	**16,321,542**
Excess Revenues Over (Under) Expenditures	**1,011,852**	**119,815**	**(4,931,706)**	**(4,707,863)**

[1]Ad valorem revenues from net proceeds of mines were estimated at approximately 10 percent of total property tax revenue.

[2]The cities of Elko and Carlin combine Health and Welfare into one line item; Eureka County does not have a Welfare line item.

Sources: Nevada Department of Taxation 2007 (Schedules S-1 from local government entities' FY 2007 to 2008 budgets).

Elko County anticipated revenues of $33.3 million against planned expenditures of $38.3 million, resulting in an expected deficit of $4.9 million. Eureka County anticipated revenues of $11.6 million and expenditures of $16.3 million. Note that the expected deficit of $4.7 million was similar to Elko County's deficit with a total budget less than half the size. After covering the planned deficit, Eureka County would still have an unreserved fund balance of over $28 million. The City of Elko's FY 2006 to 2007 budget anticipated revenues of $20.9 million and expenditures of $19.9 million, producing a $1.0 million surplus. The much smaller City of Carlin planned revenues of $2.1 million and expenditures of $2.0 million, leaving a $0.1 million surplus.

The two largest revenue sources for all four local governments are projected to be property taxes and intergovernmental transfers. Expenditure emphases vary notably among jurisdictions, as illustrated in **Table 3.12-3**.

BGMI paid $326,170 in property taxes to Elko County and $2,455,556 to Eureka County in 2006 for the Goldstrike Mine property (Hofland 2007). These payments represented 3.9 percent of Elko County's total property tax revenue and fully 45.9 percent of Eureka County's total property tax revenue, which illustrates the importance of the mine to Eureka County, in particular.

BGMI's Betze Pit (and most of the Goldstrike Mine) is in Eureka County; therefore, nearly 89 percent of the total net proceeds taxes ($12.2 million in 2006) accrue to Eureka County, while Elko County collected 10 percent, and Lander County collected 1 percent (Hofland 2007). Net proceeds of mines constitute nearly 40 percent of the total assessed valuation in Eureka County, but slightly less than 6 percent of Elko County's total assessed valuation. Elko County's ad valorem tax rate was $0.8386 per $100 of assessed value for FY 2006 to 2007; Eureka County's rate was a similar $0.8458 per $100 of assessed value. Net proceeds of mines constitute only a tiny fraction of the total assessed valuation in the City of Elko and none of Carlin's assessed valuation.

Net proceeds taxes from mine production are particularly important to Eureka County's general fund budget. The actual amount received (not the budgeted amount) from net proceeds of mines was slightly over $2.5 million in FY 2006 to 2007, which was nearly 22 percent of what Eureka County budgeted for general fund revenues (Rebaleati 2007). Net proceeds taxes also contribute to Elko County's budget, but to a relatively smaller degree. Elko County's general fund received over $0.5 million in FY 2006 to 2007, which was approximately 1.6 percent of the county's budgeted revenue (Minor 2008). School districts also are major beneficiaries of revenue from taxes on net proceeds of mines; numerous other county funds receive smaller amounts from that source.

Both Elko County and Eureka County assess 6.5 percent sales and use taxes. The mine purchases material and services in both Elko County and Eureka County, generating sales and use tax payments to both. Sales and use tax payments totaled $26.7 million in 2006, with an estimated 75 percent attributed to Eureka County and 25 percent to Elko County (Hofland 2007). The counties don't realize all the benefit of the tax, however, because 2 percent (31 percent of the revenue collected) goes to the state general fund and 2.25 percent (35 percent of the revenue) goes to school districts. The county where the tax is generated receives 0.5 percent (8 percent of the revenue), and the remaining 1.75 percent (27 percent of the revenue) is distributed to all counties under a statutory formula (Nevada Department of Taxation 2006, 2007).

3.12.1.7 Social Conditions

Elko, Spring Creek, and Carlin, in western Elko County, grew very rapidly in the 1980s, due to a boom in mining and related support activities, but stabilized in subsequent years when they experienced years of modest population growth and decline through about 2003. Growth has resumed in recent years, but at more moderate rates. The passage of time and the community's ability to weather not only the booms, but also subsequent downturns, have allowed for development of the relatively stable social setting that now exists in Elko County. Many residents have lived in the area for a number of years, social ties have become established, and residents take pride in their communities. Many of the people place a high priority on maintaining informal lifestyles and small town traditions.

Social stratification in the area is often defined by income, length of residence, educational attainment, and ethnicity. Local residents earning high incomes are considered to be the most influential in the community. The most powerful groups viewed by residents as making decisions about the area's future include federal and state government, county commissioners, environmental organizations, and large corporations (BLM 2002a).

Gold prices continue to be a key factor driving the growth or decline of the communities. When prices dropped in the late 1990s, workers were laid off, some mines announced early closures, and expansion plans were mothballed. As prices have risen recently, the reverse is true. Several mines are working towards implementing growth plans to take advantage of the opportunity. Although Elko County is more diversified than it was 2 decades ago, the mining industry is still an important sector, affecting both the economy and the psychology of area communities.

3.12.2 Environmental Consequences

The primary issues related to social and economic values include:

- Effects associated with the continued employment of current BGMI workers at the proposed project site;
- The potential growth effects of increased employment required for the proposed project;
- The economic impacts of 4 years of additional employment for a large proportion of the mining workforce in the area;
- The effects of the No Action Alternative as work forces from existing mines may be unable to find local employment after closure of approved projects; and
- The effects of the closure of the Goldstrike Mine (as they relate to both the Proposed Action and No Action Alternative).

3.12.2.1 No Action Alternative

Population and Demography

Under the No Action Alternative, mining of the Betze Pit would continue to operate until the end of 2011. Subsequent to the end of mining, processing of ore stockpiles would continue for approximately 14 additional years, followed by reclamation and closure lasting approximately 3 to 5 years.

The specific effect on study area population is uncertain. With an average family size of 3.33 people in Elko County, where over 95 percent of the Goldstrike Mine workers live, as many as 5,100 county residents (11 percent of the county population) are currently directly supported by the mine. An additional increment of the population, perhaps as many as 4,300 people based on the multiplier effect addressed below, is indirectly supported by the mine as well. A potentially affected total of 9,400 people would be over 19 percent of the study area population.

It is assumed that layoffs would begin at the time mining was completed, if not before, and that additional layoffs would occur as stockpile processing wound down 14 years later, with nearly all employees gone at the time of closure, but the actual pace of layoffs is unknown. The unemployment rate in the study area is currently quite low. If it remains low, and other mining projects in the area remain in a growth mode, it is likely that many laid off BGMI workers would remain in the community to search for new jobs, at least initially, which would result in a lessening of population losses in the study area. However, the availability of alternative employment in the area from 4 to 20 years in the future is difficult to predict. Ultimately, it is expected that a substantial number of current workers and their families may have to leave the area to find employment.

It is assumed that the workers at the Goldstrike Mine approximately reflect the ethnic and racial pattern of the study area. As such, it is unlikely that any population change related to early termination of production at the mine would alter the demography of the study area.

Income, Economy, and Employment

As noted above, closure of the Betze Pit under the No Action Alternative would require reduction of the workforce beginning about 2011. There are currently approximately 1,600 workers employed at the mine, representing more than one-quarter of the "natural resources and mining" workers and 6.5 percent of all workers in Elko and Eureka counties (**Table 3.12-2**). It is not known how many of these jobs would be lost in the short term or how rapidly layoffs would occur after 2011, although it is reasonable to assume that nearly all would be terminated between 2011 and final closure of the project, which would occur in approximately 2026.

If large numbers of workers were terminated simultaneously, the unemployment rates for Elko and Eureka counties would increase substantially.

Any loss of jobs also would reduce the dollars flowing into the local and state economy. The Goldstrike Mine provided an estimated $153.4 million in wages and salaries in 2006, including benefits. The mine also purchased supplies, services, and commodities worth an estimated $411.5 million in the state. Under the No Action Alternative, the combined $564.9 million per year of annual labor and materials currently flowing into the Nevada economy would decline, beginning in 2011 with the end of mining.

In addition to the direct employment and income provided by the Goldstrike Mine, the economic activity spawns indirect and induced employment and income in the local economy. Employees of the mine spend their income in the local area for goods and services, which provides opportunities for other businesses selling cars, groceries, and fuel to hire workers and for service providers such as the school district to hire teachers. It has been estimated that each direct employee in the hard rock mining industry generates demand for an additional 0.85 indirect and induced employees in the Elko/Eureka counties economy (Price and Harris 2007). Also, each $1.00 of direct labor income ("labor income" includes the sum of employee compensation and proprietor income) from the hard rock mining sector generates an additional $0.38 of indirect and induced labor income (Price and Harris 2007). Based on these multipliers, the loss of 1,600 jobs from the Goldstrike Mine would result in the loss of an additional 1,360 jobs in the rest of the Elko and Eureka counties' economy. In addition, it would result in a loss of approximately $142.1 million in direct labor income plus approximately $54.0 million in indirect and induced labor income.

As noted above, the timing of the job losses is not precisely known. It is assumed that the losses would begin in 2011 and continue over the following 13 to 15 years. The actual effects on the study area economy would depend on both the timing of layoffs and the type and availability of other employment that may be available in the area when the layoffs occur. Some laid off workers would be expected to find replacement employment in the area, although it is uncertain whether they would find jobs at wage levels they currently have.

Housing

Effects on the local housing market from the No Action Alternative would depend on the capacity of the local economy to absorb workers into new jobs. If a majority of the workers find new jobs in or near Elko County in a reasonable period of time, it is expected that housing market effects would be minor. There could be a short-term, minor downward influence on demand and prices. Under current conditions, with low vacancy rates in the homeowner segment of the market, this would be a minor source of irritation in the market. If the housing market were in a downturn at the time, the adverse effect would be more detrimental.

The size of the Goldstrike Mine workforce is substantial. If, ultimately, many workers could not find new local employment or had to settle for new jobs at lower wage rates, the effects on the housing market would be worse. Some families might leave the area; others might have difficulty maintaining mortgages obtained with

higher incomes. The adverse effects could be moderate to substantial because of the percentage of the total housing market represented by Goldstrike Mine workers and their families.

Community Facilities and Services

The No Action Alternative would not be expected to adversely affect most public facilities and services in the study area in the short term. Over time, as mine employment declined, some community facilities may be underutilized. Assuming some portion of the population would depart the area, service demands would decline and the need for services would be reduced (possibly resulting in loss of service jobs, which are part of the induced employment noted above). Some families might have difficulties making payments for services until and unless they were able to find new employment in the area. Growth pressure on public services and facilities would be reduced, at least for a period of time. The greatest effect could be on the school district if some families were forced to leave the area to find new employment. A loss of school-aged children would result in enrollment declines and, perhaps, underutilization of school facilities.

Public Finance

In addition to wages, salaries, and purchases, the Goldstrike Mine annually pays taxes and fees to local and state agencies. The Goldstrike Mine paid an average of $36.9 million per year in taxes from 2004 through 2006, including $11.4 million in net proceeds taxes, $21.6 million in sales and use taxes, $0.6 million in business activity taxes, and $3.4 million in ad valorem property taxes (Hofland 2007). These dollar flows would likely continue at similar levels through the end of mining in 2011, and would then decline over time to a small fraction of current levels between the end of mining and complete closure of the project 13 to 15 years later.

Social Conditions

The No Action Alternative, which would result in job losses for over 1,600 mine workers and, potentially, several hundred others from secondary jobs, would be expected to increase stress on the individuals and families involved. Their quality of life would be adversely affected for at least the period of time they were unemployed, and longer if replacement jobs resulted in a reduced standard of living. The proportion of the total local population affected would not be large enough to dramatically alter the social structure of the community, but closure of one of the largest mines in the study area could be expected to adversely affect the security and confidence of people beyond those personally affected by a downsizing.

3.12.2.2 Proposed Action

Population and Demography

Implementation of the proposed Betze Pit Expansion Project would have no permanent effect on the population or demographics of Elko or Eureka counties as the permanent workforce is already in place at the existing mine. There may be an increase in temporary contract workers to perform prestripping operations, but it is expected that prestripping would be conducted by local workers. Prestripping also would be of relatively short duration so any non-local workers involved would be unlikely to move their families to the area. With no change in the permanent workforce, there would be no change expected in the permanent population of the study area.

Income, Economy, and Employment

The current Goldstrike Mine workforce of approximately 1,600 would continue to be employed for an additional 4 years beyond the currently permitted operation. The proposed Betze Pit Expansion Project is not expected to need any additional permanent workers beyond the current staff. The effects of closure would occur at some point in time, probably 4 years later than in the No Action Alternative. The base of economic activity provided by wages and local purchases by the mine would continue with only minor adjustments as the project's three major components were developed and brought on line. The local economy would benefit from continuation of current activity for an additional 4 years. In addition, local communities in the study area would have additional time in which to continue their efforts to diversify their economies, which are currently heavily

dependent on mining in Eureka County and well above the state average for dependence on mining in Elko County. Economic development efforts are long term endeavors that take time to produce results. Continuation of mining operations at the Betze Pit for an additional 4 years would be notably beneficial to such efforts in the study area.

Housing

With no change in permanent employment or population, there would be no anticipated increase in the demand for permanent housing. Temporary non-local contract workers, if any, would need temporary housing. With over 1,500 hotel, motel, and casino rooms in Elko and numerous RV spaces with full hookups, there should be no problem housing a relatively small number of temporary workers, if necessary, without adversely stressing the housing market. A minor, project-related increase in the demand for temporary housing would be a beneficial local economic effect.

Community Facilities and Services

The proposed Betze Pit Expansion Project would have no long-term effect on service demands because the permanent workforce is already resident in the community. Depending on how many, if any, non-local contract workers are needed for the mine preparation projects, there could be a minor increase in the need for law enforcement efforts for low level criminal behavior. Any increase would be expected to be accommodated by the existing capabilities of the Elko and Carlin police forces and the Elko and Eureka County Sheriffs.

The very minor increase in demand for other public facilities and services, such as the hospital and the water and sewer systems, should be well within the existing capacities of the systems to accommodate them. It is unlikely that measurable numbers of additional school age children would join the community as a result of minor contract prestripping activity.

Public Finance

Developing the Betze Pit Expansion Project would extend the life of the mine for 4 years. As such, it would continue the provision of revenues to local governments, school districts, and certain other taxing jurisdictions, and to the State of Nevada for the duration of the additional mine life. From 2004 through 2006, BGMI generated annual revenues averaging $11.4 million from net proceeds taxes, $21.6 million from sales and use taxes, $0.6 million from business activity taxes, and $3.4 million from ad valorem property taxes. These levels of tax payments are likely to continue at similar levels for the additional 4 years of mine life, with the possible exception of net proceeds taxes, which can be highly variable, depending on gold prices and production costs.

Social Conditions

With no substantive change in permanent employment or population expected from the proposed Betze Pit Expansion Project, it is not expected to cause adverse changes in the social structure or traditional lifestyles of Elko County communities. A possible influx of a small number of contract workers would not noticeably affect the quality of life of people currently living in the community. Continuation of the Betze mining activity and the jobs of current employees would be expected to sustain their individual lifestyles, but would have little or no effect on the social structure of the community as a whole. Extending the life of the mining activity could, however, be beneficial to the long-term sustainability of the community as it would provide additional time for local economic diversification efforts to bear fruit.

3.12.2.3 Bazza Waste Rock Facility Alternative

Population and Demography

The Bazza Waste Rock Facility Alternative would require hiring 20 additional workers for approximately 2 years during 2011 and 2012. Although the unemployment rate in Elko and Eureka counties is a relatively low 3.5 percent, there are an estimated 1,000 unemployed workers in the 2 counties (NDETR 2007). Consequently, it is assumed that most, if not all, of the new workers would be hired locally. Under this

assumption, there would be little or no effect on population or demography in the two-county study area from implementation of the Bazza Alternative.

Income, Economy and Employment

The Bazza Alternative would add 5 additional trucks to the haul fleet for approximately a 2-year period during 2011 and 2012. The trucks would add estimated capital costs of $19 million and would require hiring 20 additional drivers to operate them, over and above the existing Goldstrike workforce which would continue at current levels under the Proposed Action.

Twenty new workers would increase the total Goldstrike workforce by 1.3 percent. They would increase total employment in Eureka County by less than 0.5 percent and Mining and Natural Resources employment by just over 0.5 percent. Twenty hires would represent 2.0 percent of the estimated 1,000 workers currently unemployed in the two-county area, which would only minimally reduce the unemployment rate, assuming all 20 were hired locally.

Assuming the new workers would be hired at approximately the overall average compensation rate for the mine workforce, 20 additional workers would increase total salary and benefits payroll by approximately $1.9 million per year for 2 years. Further assuming the multiplier effect at $0.38 of indirect and induced labor income for each $1.00 of direct labor income (Price and Harris 2007), there would be an additional $0.7 million per year of labor income generated under this alternative for a total of $2.6 million per year for 2 years.

Housing

Since the effect on population in the study area from the Bazza Waste Rock Facility Alternative would be minimal, it is expected that there would be little or no effect on the housing market from this alternative.

Community Facilities and Services

With minimal to no effect on population or housing in the study area, there would be no perceptible effect on existing levels of demand for public facilities and services in the study area under the Bazza Waste Rock Facility Alternative.

Public Finance

Purchase and use of 5 additional haul trucks at $19 million would increase sales and use taxes to Eureka County and the State of Nevada by approximately $1.2 million for 2 years. An additional 5.3 million gallons of fuel would also be needed, which would increase sales tax revenues to the state and county. These additional tax revenues would represent a modest benefit to the state and county. In addition, the estimated $2.6 million per year in worker compensation would generate modest increases in sales tax revenues, primarily to the City of Elko, the two study area counties and the state with lesser benefits to the City of Carlin and other communities and counties.

3.12.3 Cumulative Impacts

The CESA for social and economic values is shown in **Figure 3.12-1**. The past and present actions and RFFAs are identified in Section 3.3.1 and shown in Section 3.1. The social and economic effects of past and present actions are reflected in the affected environment information presented in Section 3.12.1. As a result, any potential cumulative effects for past and present actions are discussed in the environmental consequences section (Section 3.12.2).

3.12.2.4 No Action Alternative

The No Action Alternative would result in declines in employment, public revenues, possibly population, and economic and social activities currently supported by the mine, beginning at the end of mining in approximately 2011. If other mines in the area reach the end of their economic lives in a similar time frame, these adverse

effects would be exacerbated by the No Action Alternative. These effects are addressed in greater detail in the Draft Leeville and SOAPA Cumulative Impact Analyses (BLM 2007b,c) and the Betze Project EIS (BLM 1991a,b) and Betze Project SEIS (BLM 2000a, 2003a).

3.12.2.5 Proposed Action

No adverse social or economic effects have been identified for the proposed Betze Pit Expansion Project. Consequently, there would be no cumulative adverse social or economic effects for the Proposed Action.

3.12.2.6 Bazza Waste Rock Facility Alternative

No adverse social or economic effects have been identified for the Bazza Waste Rock Facility Alternative. Consequently, there would be no cumulative adverse social or economic effects for this alternative.

3.12.4 Mitigation Measures and Monitoring

No mitigation or monitoring of social or economic resource effects is recommended.

3.12.5 Residual Impacts

The additional 4 years of mining will result in increased training and experience of the workforce, providing for greater employment opportunity elsewhere after the mine closes. The 4 years of mining and employment also will result in investment in homes and infrastructure in Elko that will last a very long time, and the mining of the gold will create wealth that will benefit the nation and perhaps the world for a very long time.

3.13 Visual Resources

The visual resources study area for the proposed project is defined as the viewshed of the project, or the area from which the project can be seen. The viewshed includes an area bounded by foothills and ridges on the east and north and less well-defined topographic rises to the south and west of the project site. The project area is located in the Rodeo Creek and Brush Creek drainages above the Boulder Valley, between the Sheep Creek Mountain Range and Tuscarora Mountain Range. The CESA encompasses existing activities and reasonably foreseeable mining activity on the Carlin Trend (**Figure 3.13-1**).

The proposed project is located in the Basin and Range Physiographic Province, as defined by Fenneman (1931). This province is characterized by extensive vistas, and alternating valleys and north-south trending mountain ridges.

The BLM is responsible for identifying and protecting scenic values of public lands under several provisions of the FLPMA and NEPA. The BLM Visual Resource Management (VRM) system was developed to facilitate the effective discharge of that responsibility in a systematic, interdisciplinary manner. The VRM system provides the methodology to:

- Inventory existing scenic quality;
- Assign visual resource inventory classes based on a combination of scenic values, visual sensitivity and viewing distances; and
- Assign visual management objectives.

Four visual resource classes have been established to:

- Serve as an inventory tool portraying the relative value of existing visual resources; and
- Serve as a management tool portraying visual management objectives for the respective classified lands.

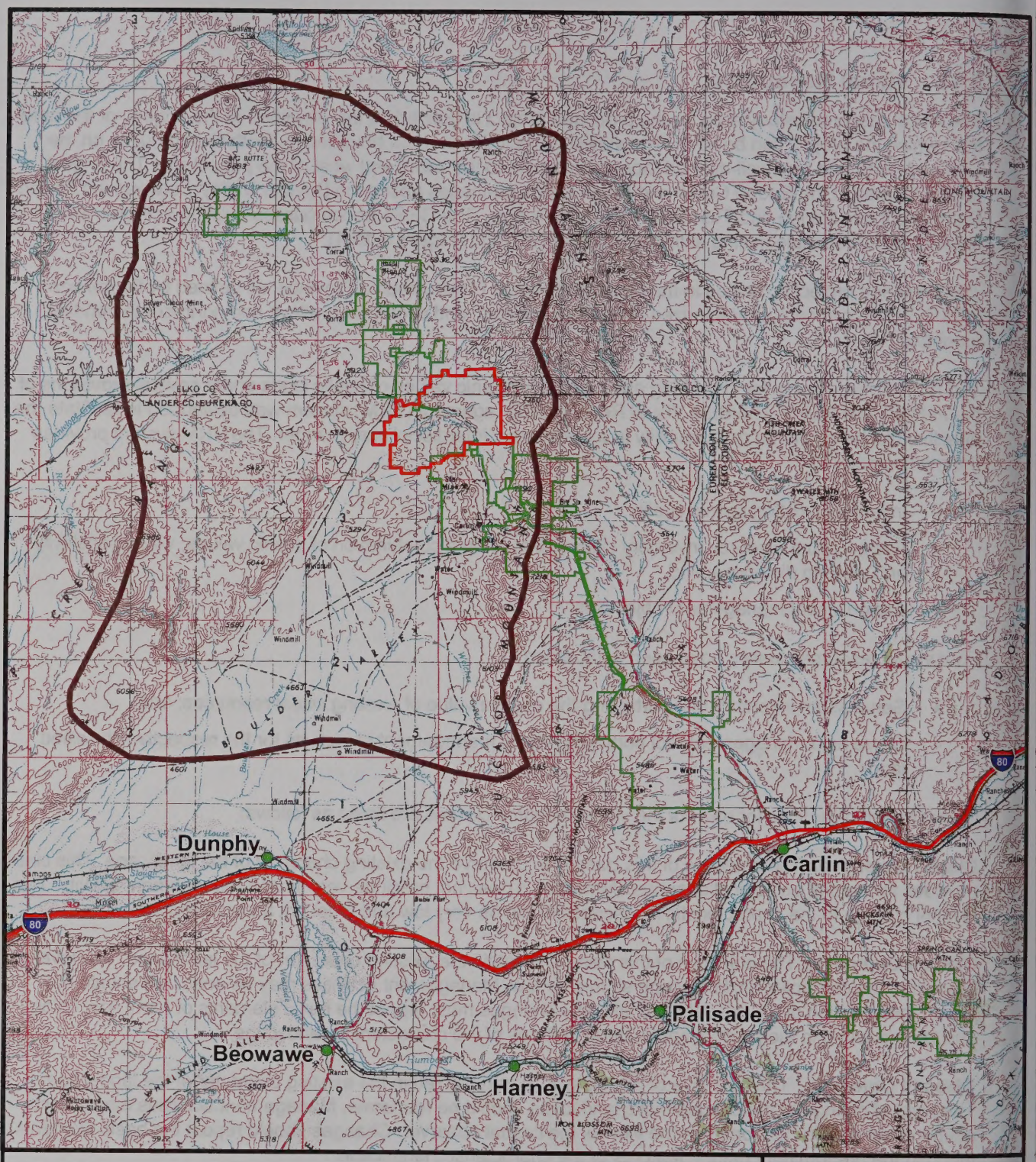
Management objectives for each of the visual resource classes are listed as follows:

Class I Objective. The objective of this class is to preserve the existing character of the landscape. This class provides for natural ecological changes. However, it does not preclude very limited management activity. The level of change to the characteristic landscape should be very low and must not attract attention.

Class II Objective. The objective of this class is to retain the existing character of the landscape. The level of change to the characteristic landscape should be low. Management activities may be seen, but should not attract the attention of the casual observer. Any changes must repeat the basic elements of form, line, color, and texture found in the predominant natural features of the characteristic landscape.

Class III Objective. The objective of this class is to partially retain the existing character of the landscape. The level of change to the characteristic landscape should be moderate. Management activities may attract attention but should not dominate the view of the casual observer. Changes should repeat the basic elements found in the predominant natural features of the characteristic landscape.

Class IV Objective. The objective of this class is to provide for management activities that require major modification of the existing character of the landscape. The level of change to the characteristic landscape can be high. These management activities may dominate the view and be the major focus of viewer attention. However, every attempt should be made to minimize the impact of these activities through careful location, minimal disturbance, and repeating the basic elements.



LEGEND

- Visual Resources Cumulative Effects Study Area
- Goldstrike Mine Operations Boundary
- Mine Plan Boundaries
- Towns

N

0 2.5 5 Miles

Source: BLM 2007b,c.

Betze Pit Expansion Project

Figure 3.13-1

Visual Resources Cumulative Effects Study Area

Visual Rehabilitation Areas. Areas in need of rehabilitation from a visual standpoint are flagged during the inventory process. The level of rehabilitation is determined through the RMP process by assigning the VRM class approved for that particular area.

The VRM system also includes a contrast rating procedure for evaluating the potential visual consequences of a proposed project or management activity. The VRM system provides the basic approach for evaluating direct visual impacts as well as potential cumulative visual impacts of the proposed expansion project.

3.13.1 Affected Environment

The visual resources of the project area are composed of mountains giving way to gentle slopes and rolling hills bisected by several smaller drainages. Vegetation consists of sagebrush, rabbitbrush, and various grasses that color the hills in shades of green, gold, and brown. Grey, brown, and black coloration indicate areas of sparse vegetation, soil, and rocks.

The project area is not easily visible from any major roadway, town, or recreation area. The prominent views would be from the main access road, making the primary viewers mine employees and/or mine service contractors. Occasional four-wheel-drive recreationists and hunters would see the project area.

The topography in the vicinity of the project area is flat to moderately sloping. The existing site is situated at an elevation of approximately 5,400 feet. Surface soils and rocks in the vicinity generally range from dark umber to buff to grayish-tan hues of light-to-medium-to-dark values.

The existing operations exhibit strong color and landform contrast with the natural surroundings and moderate to strong line and surface texture contrast. The browns, light tans, and gold of the recently mined waste rock dumps stand out moderately to strongly in comparison with the surrounding natural landforms and vegetation.

Areas that have been reclaimed show substantial mitigating effects that the reclamation has had on the visual environment. The AA Leach Pad has been reclaimed with sagebrush and grasses growing on the surface that result in the reclaimed facility blending into the natural terrain. BGMI received an award in 2007 for the reclamation design of the Bazza Waste Rock Facility. BGMI was noted for its reclamation design of natural topographic features and vegetation cover of the native shrubs and grasses that would be beneficial to wildlife (Section 2.3.7.3).

Vegetation in the project area is relatively homogeneous, consisting of sagebrush shrubland and semi-desert grassland. Grasses are short and typically sparse, reflecting the arid conditions of the region. Vegetation colors in the growing season range from silvery gray-green to medium olive. During the dormant seasons, vegetation ranges from silvery gray-green of shrubs to tan, buff, umber, and gold of grasses and forbs.

Structures in the visual area of influence are limited mainly to industrial forms, colors, and characters.

The BLM has identified the project area as Class IV and has identified one Visual Rehabilitation Area. The existing mine area is located in the Visual Rehabilitation Area. Designation of a Visual Rehabilitation Area indicates the area should be managed to improve the existing visual condition. In this case, the Visual Rehabilitation Area is targeted for management to the standards of VRM Class IV, in keeping with other areas of the valley floor having similar visual characteristics.

Two KOPs have been identified in the study area; they are shown in **Figure 3.13-2**. KOP locations are utilized for analyzing detailed landscape character in the affected environment and for comparison with the characteristics of the proposed project (Section 3.13.2, Environmental Consequences). Factors considered in selecting KOPs are:

- Angle of observation;
- Number of viewers;
- Length of time the project is in view;
- Relative project size;
- Season of use; and
- Light conditions (BLM 2007e).

3.13.2 Environmental Consequences

Potential visual impacts associated with the proposed expansion of the Goldstrike Mine were analyzed using the procedures outlined in the BLM Visual Contrast Rating Handbook H-8431-1 (BLM 1986b). Visual impacts were determined by comparing visual contrast ratings for the proposed project facilities with the VRM class objective for the project area, portions of which are designated VRM Class IV. The process involves comparing the degree of visual contrast from the proposed facilities and activities with the existing landscape character both during active mining and after reclamation is completed. The contrast rating process used the two KOPs as representative viewpoints for conducting the impact analysis.

KOP #1 is located on the access road at the southern entrance to the project area. This viewpoint was selected to represent the view for travelers approaching from the south. KOP #2 is located on the Dunphy road at the northern entry to the project area and represents the view for travelers approaching from the north. These approach routes are the only improved routes to and through the project area. Most traffic in the area is generated by mineral development; there also is traffic generated by ranching and recreational activities including hunting, fishing, and camping where access is not restricted by mining company safety closures and security gates.

3.13.2.1 No Action Alternative

Under the No Action Alternative, the proposed Betze Pit Expansion Project would not be constructed. As a result, there would be no additional disturbance beyond what currently exists or is currently permitted. Rodeo Creek would be diverted from its current channel north of the Betze Pit to the south of the pit to accommodate mine expansion under current authorizations. This diversion would have minimal visual impact considering the close proximity to the Betze Pit, Bazza Waste Rock Facility, and other disturbed sites within the VRM Class IV area. Descriptions of each facility are presented in Section 2.2, No Action Alternative. Visual effects would be essentially as described in the 1991 Betze Project EIS (BLM 1991a,b). Activities permitted under these NEPA documents would continue, including reclamation of disturbance areas (BGMI 2007a), which ultimately would reduce the visual contrast from mining-related activities.

The visual effects of the existing and approved project were considered to be "less than significant" in the 1991 Betze Project EIS (BLM 1991a,b).

3.13.2.2 Proposed Action

Development of the proposed Betze Pit Expansion Project would expand the extent of the visual contrast that currently occurs between existing and previously approved mine-related facilities and the natural character of the landscape. The primary change in visual effects from the currently approved levels would be the expansion of the project footprint. Of somewhat lesser importance, the proposed project also would extend the duration of active mining, which is the time when visual effects are most prominent. Prior to completion of reclamation, the existing features exhibit strong color contrast, especially under bright, clear light conditions. In addition, there are moderate to strong line and landform contrasts generated to a large extent by the flat tops and geometric

Meikle Mine Area
North Block Tailings Facility
Elko Co.
Eureka Co.
Proposed Pit Laybacks
Perimeter Buffer to Laybacks
Roaster Facility Areal
Proposed Clydesdale Waste Rock Facility
Proposed Haul Road
Rodeo Mine
Proposed Goldstrike No. 3 Tailings Facility
AA Tailings Facility
Mill #4 Tailings Facility
Betze Pit
Process/Support Facilities
AA Leach Pad (Reclaimed)
Dunphy Road
Bazza Waste Rock Facility
Water Treatment Facility (Inactive)
TS Ranch Reservoir Area
T 36N, R 49E
T 35N, R 49E
T 36N, R 50E
T 35N, R 50E
Eureka Minor County Road 237-A

LEGEND

- Goldstrike Mine Operations Boundary
- Tailings Facility
- Pit Expansion
- Perimeter Buffer to Laybacks
- Waste Rock Facility
- Clydesdale Haul Road
- Tailings Pipeline
- Previous Disturbance
- Key Observation Point
- Unimproved Roads

Source: BLM 2000a; BGMI and SRK 2007; BGMI 2007a.

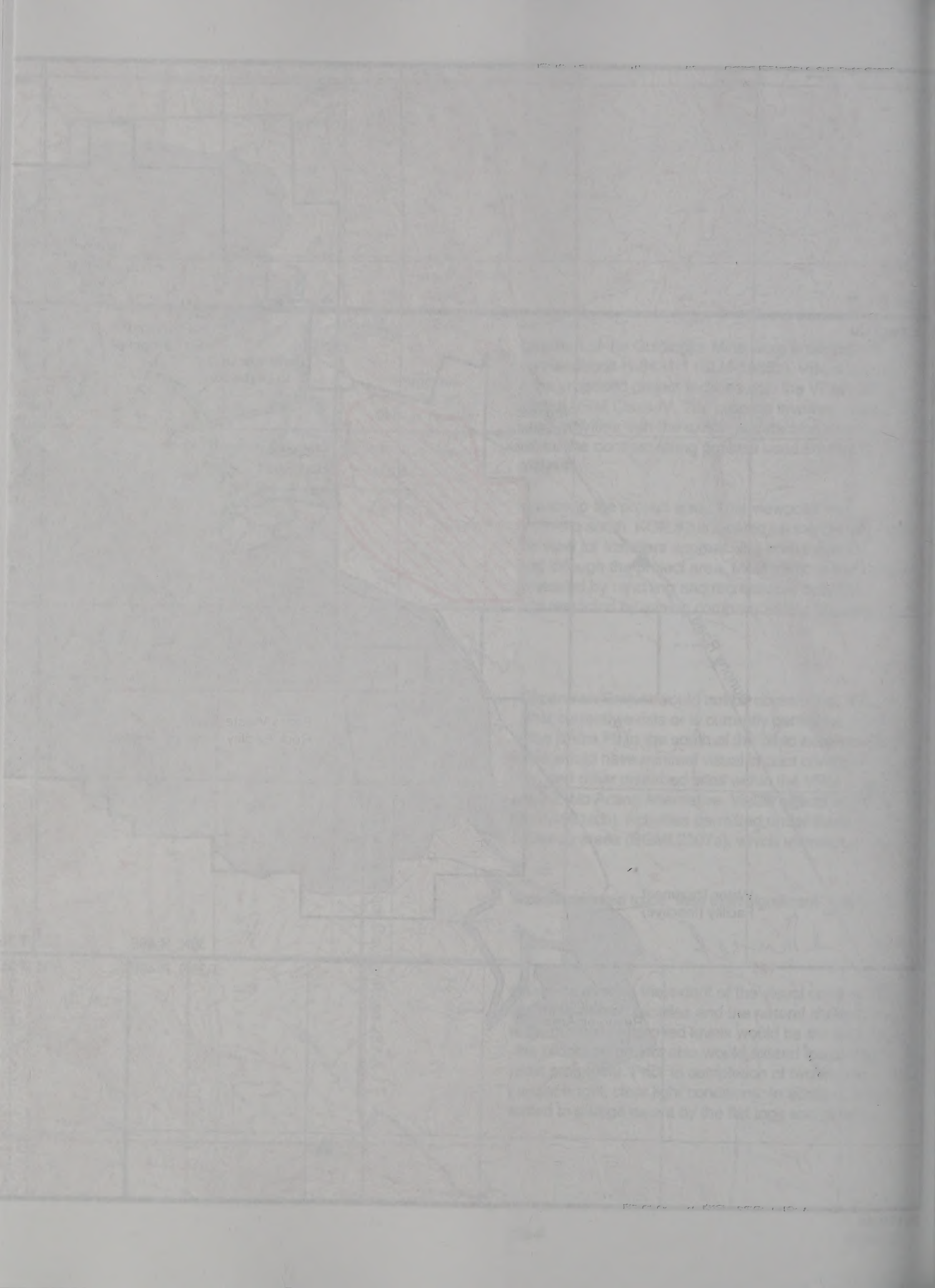
N
W E
S

0 0.5 1 Miles

Betze Pit Expansion Project

Figure 3.13-2

Key Observation Points for Visual Resources



shapes of the waste rock and tailings facilities. Finally, there is moderate texture contrast between the bare surfaces of the mine features and the vegetation textures and patterns in the natural landscape. The visual contrast effects gradually would become less prominent with implementation of reclamation.

Development of the proposed project would result in new and expanded features in the landscape. From a visual perspective, the most visible proposed features would include the new Clydesdale Waste Rock Facility, the new Goldstrike No. 3 Tailings Facility, and expansion of the Betze Pit. Descriptions of each facility (including maximum elevation above native ground surface) are presented in Section 2.3, Proposed Action.

The proposed waste rock and tailings facilities would have visual characteristics during active mining that would be similar to existing facilities, notably a geometric form and exposed rock surfaces. As a result, the proposed Betze Pit Expansion Project would have similar, but expanded, visual effects to those already occurring from the existing facilities, including strong color contrast, moderate to strong line and landform contrast, and moderate texture contrast. The key considerations, therefore, are the degree of expansion of the visual impacts, and the amount of contrast permissible under the relevant VRM class objectives.

Most visual effects of the proposed project would be seen from both KOPs #1 and #2. The Clydesdale Waste Rock Facility would rise nearly 500 feet above the existing grade; the Goldstrike No. 3 Tailings Facility would rise approximately 335 feet; and the Betze Pit layback areas would be approximately 4,300 feet long and approximately 1,100 feet wide at their maximum extent. During active mining, the disturbance would be more visually prominent than existing and previously approved activities. In addition, lighting used to facilitate around-the-clock mining would emphasize the visual contrast at night. The area proposed for disturbance is rated VRM Class IV. The class objective provides for "... major modification of the existing character of the landscape ..." therefore, the visual disturbance would be in conformance with the objective if "every effort" is made to minimize the visual impact. Recent past and on-going reclamation efforts by BGMI have been effective at mimicking natural landforms in the project vicinity. Assuming the same reclamation standards would be implemented for the proposed project, it would be expected that the visual contrasts from waste rock and tailings facilities would be substantially reduced after reclamation. BGMI has committed to constructing the margins of the waste rock facilities to provide for variable topography during final regrading, thereby providing a more natural post-mining landscape. Concurrent reclamation would be implemented to the extent possible (Section 2.2.1.13, Applicant-committed Environmental Protection Measures). As a result, the long-term visual effects would achieve the VRM class objectives of Class IV. The upper portion of the Betze Pit wall would remain visible, and the color contrast from the wall likely would remain strong for a long period of time. However, the pit would be in a Class IV area and the "major modification" standard would permit the strong contrast effect to continue if efforts are made to minimize the effect to the degree possible.

The proposed project would meet the VRM Class IV management objectives during active mining, although meeting the specific objectives regarding "minimizing disturbance" and "repeating basic elements (form, line, color, and texture)" would be a challenge in some areas. The objectives also indicate that "major modification" is anticipated and that visual dominance can be accommodated in Class IV areas. Based on the reclamation plan and applicant-committed environmental protection measures (Section 2.2.1.13), waste rock and tailings facilities would be recontoured and revegetated resulting in a smoothing and rounding of the side slopes into an irregular pattern to more closely approximate the surrounding landscape. Revegetation would be necessary in meeting the VRM class objectives, as the most pronounced visual contrast would be the color difference introduced by the bare rock in comparison to the natural vegetative color palette. Recontouring and revegetation of the waste rock and tailings facilities would "minimize the disturbance" and would bring the proposed project into conformance with the VRM objectives, once reclamation activities have been successfully implemented. As a result, the long-term visual effects would not exceed the VRM Class IV Management Objectives and visual impacts are estimated to be low. Reclamation is proposed to occur concurrently with mining to the extent possible, as discussed in Section 2.2.1.13, Applicant-committed Environmental Protection Measures. This would ensure that visual contrast would be minimized at the earliest possible time.

3.13.2.3 Bazza Waste Rock Facility Alternative

Under this alternative, up to an additional 350 million tons of waste rock would be disposed of in the existing Bazza Waste Rock Facility. The maximum height of the facility would be increased to approximately 800 feet above the original topography compared with approximately 700 feet for the existing facility. The increase in height would make the facility slightly more visible from viewpoints, but the visual impact would be minimal compared with size and height of the existing facility.

This alternative has similar long-term visual impacts as for the Proposed Action without construction of the haul road and Clydesdale Waste Rock Facility. The Bazza Waste Rock Facility Alternative would meet the VRM Class IV management objectives during active mining, although meeting the specific objectives regarding "minimizing disturbance" and "repeating basic elements (form, line, color, and texture)" would be a challenge in some areas.

3.13.3 Cumulative Impacts

The CESA for visual resources encompasses the Carlin Trend and is shown in **Figure 3.13-1**. The Carlin Trend was selected as the CESA boundary as this area incorporates the major surface disturbance activities primarily as a result of mining activities. Past, present, and RFFAs are identified in Section 3.1.

3.13.3.1 No Action Alternative

Visual effects of past and present actions are included in the description of the affected environment (Section 3.13.1). The future actions, through the year 2025, that will create visual effects are predominantly mining-related activities, including both exploration and development projects. There also will be a potential increase in the construction of dirt roads. Among these actions, the mining projects would be the most likely to introduce strong visual contrast in the cumulative effects study area. However, all of the identified future actions will be located in VRM Class IV areas, so it is anticipated that the visual disturbance would be accommodated by the standards of the VRM Class IV objectives, which provide for "major modification" of the landscape. Based on the No Action Action Alternative's reclamation plan and the assumption that standard reclamation requirements will be required for permitting of future projects, the cumulative visual effects would be minimized to the degree possible after completion of the projects.

3.13.3.2 Proposed Action

Cumulative effects to visual resources under the Proposed Action would be similar to the cumulative impacts described for the No Action Alternative except that the Proposed Action would incrementally add a new waste rock and tailings facility and would expand the Betze Pit. These additional mine facilities and associated visual disturbances are located in VRM Class IV areas that allow "major modifications" to the landscape. The cumulative visual effects would be minimized to the extent practical after reclamation was completed.

3.13.3.3 Bazza Waste Rock Facility Alternative

Cumulative impacts to visual resources under the Bazza Waste Rock Facility Alternative would be similar to the Proposed Action.

3.13.4 Mitigation Measures and Monitoring

During active mining, little can be done to reduce the landform and color contrasts without unduly interfering with mine operations. However, based on BGMIs applicant-committed environmental protection measures (Section 2.2.1.13) and this environmental analysis, the residual visual effects would be minimized to the extent possible as required by VRM Class IV objectives. As a result, no monitoring and mitigation beyond implementation of the applicant-committed environmental protection measures and reclamation plan have been identified for visual resources.

3.13.5 Residual Impacts

Increased surface disturbance and the long-term presence of surface activities in the project area would result in unavoidable adverse impacts to the visual resources that cannot be completely mitigated. Residual adverse visual effects would result from the long-term changes in landform and color contrasts associated with the Betze Pit Expansion Project landform walls. The visual effects gradually would diminish over time as natural vegetation patterns would develop to help mask the landform and color contrasts. However, the unreclaimed pit and pit walls would result in permanent visual effects.

3.14 Hazardous Materials and Solid Waste

3.14.1 Affected Environment

The affected environment for hazardous materials includes air, water, soil, and biological resources that potentially could be affected by an accidental release of hazardous materials during transportation to and from the mine and during storage and use at the mine. The study area for direct and indirect impacts for hazardous materials and solid waste encompasses the Goldstrike Mine operations boundary and transportation routes for hazardous materials and wastes between I-80 and Goldstrike Mine, including SR 766 and Eureka County Road 237A (**Figure 3.14-1**). The CESA for hazardous materials and solid waste encompasses the permitted mine sites in the Carlin Trend (**Figure 3.1-2**).

3.14.1.1 Project-related Hazardous Materials

The mining and ore processing operations for the proposed project would require the use of the following materials classified as hazardous:

- Diesel fuel, gasoline, oils, greases, anti-freeze, and solvents used for equipment operation and maintenance;
- Sodium cyanide, sodium hydroxide, acid, flocculants, lime, and antiscalants used in mineral extraction processes;
- Ammonium nitrate and high explosives used for blasting in the open pits; and
- Various by-products classified as hazardous waste and chemicals used in the existing assay laboratory.

There would be no change in the current reagent consumption rate at the existing operations.

3.14.1.2 Regulatory Framework for Hazardous Materials

"Hazardous materials," which are defined in various ways under a number of regulatory programs, can represent potential risks to both human health and the environment when not properly managed. The term "hazardous materials" includes the following materials that may be utilized or disposed of in conjunction with mining operations:

- Substances covered under Occupational Safety and Health Administration and MSHA Hazard Communication Standards (29 CFR 1910.1200 and 30 CFR 42): the types of materials that may be used in mining activities and that would be subject to these regulations would include almost all of the materials identified above.
- "Hazardous materials" as defined under USDOT regulations at 49 CFR, Parts 170-177: the types of materials that may be used in mining activities and that would be subject to these regulations would include sodium cyanide, explosives, cement, fuels, some paints and coatings, and other chemical products.
- "Hazardous substances" as defined by Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and listed in 40 CFR Table 302.4: The types of materials that may contain hazardous substances that are used in mining activities and that would be subject to these requirements would include sodium cyanide, solvents, solvent-containing materials (e.g., paints, coatings, degreasers), acids, and other chemical products.

"Hazardous wastes" as defined in the Resource Conservation and Recovery Act (RCRA): procedures in 40 CFR 262 are used to determine whether a waste is a hazardous waste. The types of materials used in mining activities and that could be subject to these requirements could include liquid waste materials with a

flash point of less than 140°F, spent solvent containing wastes, corrosive liquids, and lab assay wastes. Hazardous wastes are regulated under Subtitle C of RCRA.

- Any "hazardous substances" and "extremely hazardous substances" as well as petroleum products such as gasoline, diesel, or propane, that are subject to reporting requirements if volumes on-hand exceed threshold planning quantities under Sections 311 and 312 of Superfund Amendments and Reauthorization Act (SARA): the types of materials that may be used in mining activities and that could be subject to these requirements would include fuels, coolants, acids, and solvent-containing products such as paints and coatings.
- Petroleum products defined as "oil" in the Oil Pollution Act of 1990: The types of materials used in mining activities and that would be subject to these requirements include fuels, lubricants, hydraulic oil, and transmission fluids.

In conjunction with the definitions noted above, the following lists provide information regarding management requirements during transportation, storage, and use of particular hazardous chemicals, substances, or materials:

- The SARA Title III List of Lists or the Consolidated List of Chemicals Subject to Emergency Planning and Community Right-to-Know Act and Section 112(r) of the CAA; and
- The USDOT listing of hazardous materials in 49 CFR 172.101.

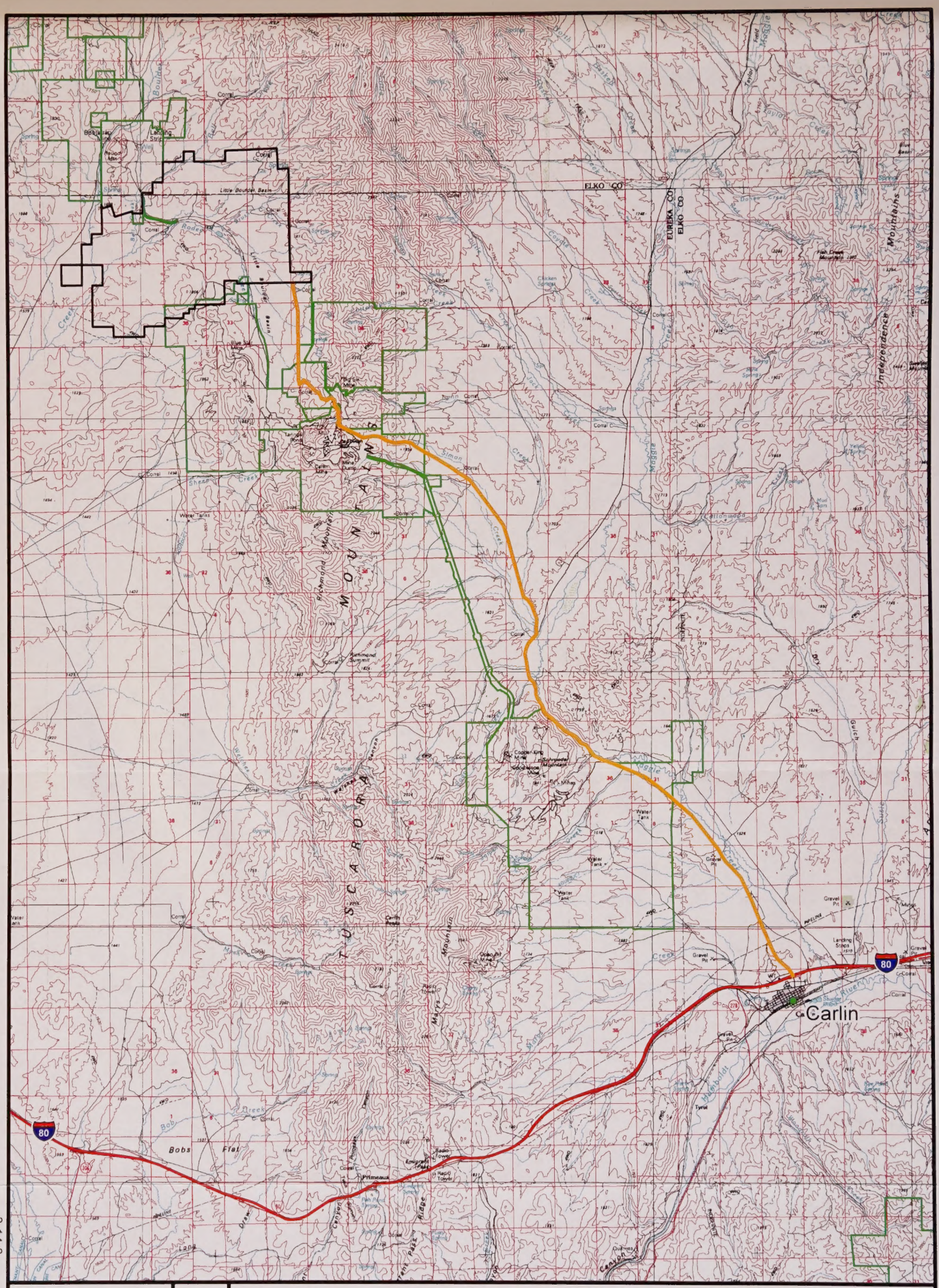
Certain types of materials, while they may contain potentially hazardous constituents, are specifically exempt from regulation as hazardous wastes. Used oil, for example, may contain toxic metals, but would not be considered a hazardous waste unless it meets certain criteria. Other wastes that might otherwise be classified as hazardous are managed as "universal wastes" and are exempted from hazardous waste regulation as long as those materials are handled in ways specifically defined by regulation. An example of a material that could be managed as a universal waste is lead-acid batteries. As long as lead-acid batteries are recycled appropriately, requirements for hazardous waste do not apply.

Pursuant to regulations promulgated under CERCLA, as amended by SARA, release of a reportable quantity of a hazardous substance to the environment must be reported within 24 hours to the National Response Center (40 CFR Part 302). The NAC (445A.347) also requires immediate reporting of a release of a reportable quantity of a hazardous substance to the Nevada Division of Emergency Management. In addition, under the State of Nevada Water Pollution Control Permit program, all releases of a reportable quantity must be reported as soon as possible, but not later than 24 hours after the event, to the NDEP Bureau of Corrective Actions. Nevada regulates the storage and handling of certain defined "highly hazardous substances" under NAC 459.952-459.9542.

Incidental spills of hazardous substances in the study area have occurred during previous mining and mineral processing operations at the project site. All reported spills have been mitigated, and contaminated materials have been managed in accordance with federal and state regulations.

3.14.1.3 Regulatory Framework for Solid Waste

Solid waste consists of a broad range of materials that include garbage, refuse, wastewater treatment plant sludge, non-hazardous industrial waste, and other materials (solid, liquid, or contained gaseous substances) resulting from industrial, commercial, mining, agricultural, and community activities (USEPA 2003). Solid wastes are regulated under different subtitles of RCRA and include hazardous waste (discussed in the previous section) and non-hazardous waste. Non-hazardous wastes are regulated under RCRA Subtitle D. In Nevada, solid waste rules are found in the NAC. Disposal of solid waste is regulated under NAC 444.570-444.7499; disposal of hazardous waste is regulated under NAC 444.850-444.8746.



3.14-3

LEGEND

- Goldstrike Mine Operations Boundary
- Hazardous Materials Study Area/Transportation Corridor
- Mine Plan Boundaries

N

0 2 4 Miles

Source: BLM 2007b,c.

Figure 3.14-1
Hazardous Materials Study Area

Betze Pit Expansion Project

06/06/2008



3.14.1.4 Solid Wastes Generated from Mining Operations

The major wastes within the study area include hazardous waste, petroleum contaminated soil, construction debris, trash, and sanitary waste. The Goldstrike Mine generates enough hazardous waste to be considered a large quantity generator under the RCRA waste generator rules (greater than 2,200 pounds per month). Petroleum contaminated soil is treated at an on-site bioremediation treatment facility. Construction debris and trash are disposed of at an on-site landfill, and sanitary wastes are treated in a wastewater treatment system. **Table 3.14-1** lists hazardous waste generated typically on an annual basis.

Table 3.14-1 Goldstrike Mine Hazardous Waste Generated in 2005[1]

Type of Waste	Quantity Generated (lbs)
Aerosol Can Waste	1,162
Aerosol Filters, Paint Filters	280
Waste Paint Related Material	1,126
Debris Contaminated w/used oil and Tetrachlorethylene	250
Inorganic Lab Waste	185,658
Computer	34,220
Baghouse Dust from Assay Lab	10,151
Brick, Mortar, and Soil	19,180
Hepa Filters and Debris	14,240
Used Oil Contaminated with Tetrachlorethylene	21,912
Used Oil Contaminated with Trichloroethylene	13,031
Used Solvent	457
Waste Lead/Acid Batteries	400
Lead Contaminated Sandblast Grit	8,952

[1]All hazardous waste is sent to a Transfer Storage Disposal Facility.

Source: BGMI (2006a,b).

3.14.2 Environmental Consequences

3.14.2.1 No Action Alternative

Important issues related to the presence of hazardous materials at the Goldstrike Mine are the potential impacts to the environment from an accidental release of hazardous materials during transport to the project area or a release related to use or storage at the site.

Under the No Action Alternative, the proposed Betze Pit expansion would not occur. However, the transport, storage, use, and disposal of hazardous materials for the ongoing processing of ore at the existing Goldstrike Mine would continue until recovery has been completed. The type and frequency of hazardous materials shipments would not change from present authorized consumption and use. There would be a low likelihood of a hazardous material release during transportation. In addition, the existing facilities have an Environmental Incident Response Manual in place that provides the training and facility infrastructure to minimize the potential

effects of a hazardous materials spill (BGMI 2007b). The No Action Alternative would present a very low potential for a significant impact involving a release of hazardous materials during transportation and storage.

3.14.2.2 Proposed Action

Under the Proposed Action the transport, storage, use, and disposal of hazardous materials for mine operations would continue for an additional 4 years beyond the time frame for the No Action Alternative. The type and frequency of hazardous material shipments would not change from current authorized consumption and use. If some of the chemicals identified for use during the life of the proposed expansion were to enter the environment in an uncontrolled manner, there could be associated direct or indirect adverse effects. The environmental effects of a release would depend on the substance, quantity, timing, and location of the release. The event potentially could range from a minor oil spill on the project site where cleanup equipment would be readily available, to a severe spill large release of sodium cyanide solution. As a result, the potential risk for impacts due to spills would be the same as discussed under the No Action Alternative.

Transportation

All hazardous substances would be transported by commercial carriers or vendors in accordance with the requirements of Title 49 of the CFR. Carriers would be licensed and inspected as required by Nevada Department of Transportation and USDOT. Tanker trucks would be inspected and would have a Certificate of Compliance issued by the Nevada Motor Vehicle Division. These permits, licenses, and certificates are the responsibility of the carrier. Title 49 of the CFR requires that all shipments of hazardous substances be properly identified and placarded. Shipping papers must be accessible and must include information describing the substance, immediate health hazards, fire and explosion risks, immediate precautions, fire-fighting information, procedures for handling leaks or spills, first aid measures, and emergency response telephone numbers. Goldstrike Mine was certified May 17, 2007, by the ICMC (ICMC 2008). This certification applies to the manufacture, transport, and use of cyanide in the production of gold.

A large-scale release of fuel or reagents would have implications for public health and safety. The location of the release would again be the primary factor in determining its importance. A release in a populated area could have effects ranging from simple inconvenience during cleanup to potential loss of life if an explosion and fire were involved. However, the probability of a release anywhere along a transportation route is very small; the probability of a release within a populated area is smaller; and the probability of a release involving an injury or fatality is smaller still. USDOT statistics show that for the State of Nevada from 2002 to 2005, no fatalities resulted from large truck transportation incidents involving a hazardous material release (USDOT 2007). Over the same time period, there were a total of six releases of hazardous materials from large truck transportation incidents. Fifty percent of the releases involved flammable liquid. It is not anticipated that a release involving severe effects to human health or safety would occur during the life of the project. The total number of crashes involving large trucks carrying hazardous materials during the 2002 to 2005 period was 42 for the State of Nevada. Six of the incidents occurred in Elko County, and two occurred in Eureka County (USDOT 2007).

Storage and Use

BGMI has developed a Spill Prevention, Control, and Countermeasures (SPCC) Plan in accordance with 40 CFR Part 112, which describes the required level of containment and safety measures associated with storage, handling, and spill clean-up of oil (includes but not limited to petroleum, fuels, sludge, used oil, and mineral oil) (BGMI 2007b). Operations conducted in accordance with the SPCC Plan would ensure that impacts from spills would be minimized and the spilled materials contained and removed. BGMI would have the necessary spill containment and cleanup equipment available at the site, and personnel would be able to quickly respond.

In the event of a spill of hazardous waste occurring on site, BGMI has prepared an Environmental Incident Response Manual that establishes procedures for preventing, controlling, and reporting environmental releases within or from facilities located at the Goldstrike Mine (BGMI 2007b).

Environmental effects of releases are minimized by prompt clean up of impacted media. **Table 3.14-2** summarizes large spills that occurred from July 2002 to July 2003 and is provided as an example of the types of spills and spill frequency that might be expected during mining operations. Most of the spills consist of diluted water-cyanide solutions while the rest are fuel or oil. Petroleum contaminated soil (PCS) is handled onsite in a two-step process. PCS is excavated from the spill site and taken to a permitted biotreatment facility. After treatment, it then is used for supplemental fuel in the facility roaster. Typically, about 300 to 500 cubic yards of soil is brought to the biotreatment facility on an annual basis. For spills of WAD cyanide (CN) solutions that impact soil, soils are immediately excavated and the excavated area is sampled (Girardo 2008). The clean up confirmation soil samples are tested at an independent laboratory to ensure that the area has been adequately cleaned up and no impacted soil remains. Spill areas are excavated until laboratory analyses indicate non-detect in confirmation samples. If laboratory analyses indicate non-detect concentrations, the excavations are backfilled with clean soil. As a Bevill Amendment exempt waste, soils impacted by WAD CN solution spills are placed on leach piles or tailing impoundments. Such handling of spill impacted media ensures that the public health and environment are protected from the effects of hydrocarbons or process solutions.

Table 3.14-2 Large Spills Recorded from June 2002 to July 2003 at the Goldstrike Mine

Date	Material	Quantity and Concentration (ppm)	Location
07/17/02	Hydraulic oil	70 gallons	South Ramp, Betze pit; T36N, R49E, Sec. 30
08/07/02	Reclaim/fresh water	25,600 gallons/0.2 ppm WAD CN	N.B. seep pump return line; T36N, R50E, Sec.18
08/07/02	Reclaim/fresh water	14,000 gallons/0.14 ppm WAD CN	N.B. seep pump return line; T36N, R50E, Sec.18
09/20/02	Form oil	230 gallons	Meikle 1225 vent access; T36N, R49E, Sec.13
10/05/02	CIL clean-out solution	3,500 gallons/0.48 ppm WAD CN	Mill crusher #2 feed surge pile; T36N, R50E, Sec. 29
01/06/03	Diesel fuel	200 gallons	Q5 parking area, R36E, T49N, Sec. 19
01/21/03	Gear oil	200 gallons	Roaster primary crusher; R36E, T49N, Sec. 13
06/23/03	Acidulation slurry	3,900 gallons/0.1ppm WAD CN	603 Acidulation Tank, T36N, R50E, Sec. 29
07/24/03	Reclaim and fresh water mixture	145,000 gallons/0.02 ppm WAD CN	AA Emergency Containment Pond/Storm Containment Pipe; T36N, R50E, Sec. 20
07/25/03	Used oil	94 gallons	Meikle – road west of vent shaft

Source: BGMI and SRK 2007.

The existing processing facilities, which would be used under the proposed project, were designed to minimize the potential for an upset that could result in a major spill. The SPCC Plan and the Emergency Response and

Contingency Plan would continue to be in place to provide the structures, procedures, and training to minimize the impacts of spills of hazardous materials.

All hazardous substances would be handled in accordance with applicable MSHA regulations (Title 30 CFR). The hazardous materials to be used under the Proposed Action would be handled as recommended on the manufacturer's Material Safety Data Sheets. Based on the facility's design features and the operational practices in place, the probability of a major release occurring at the site during the life of the proposed mine expansion would be low.

Disposal

All hazardous waste generated at the mine (including any liquid lab wastes that meet the hazardous waste criteria) would be transported to licensed disposal facilities in accordance with applicable federal and state regulations. Other solid wastes would be disposed of appropriately depending upon waste type.

Potential Effects of a Release

The environmental effects of a release would depend on the material released, the quantity released, and the location of the release. Potential releases could include a small amount of diesel fuel spilled during transfer operations at the mine site or the loss of several thousand gallons of sodium hydroxide, diesel fuel, or sodium cyanide into a riparian drainage. In general, the materials of greatest concern would be sodium cyanide, sodium hydroxide, and diesel fuel.

The release of a hazardous material or waste into a sensitive area (such as stream, wetland, or populated area) is judged to be very unlikely. Depending on the material released, the amount released, and the location of the release, an accident resulting in a release could affect soils, water, biological resources, and human health.

Response to a Release

All spills, including transportation and loading/unloading spills occurring on site, would be cleaned up as soon as possible. If a spill exceeds reportable quantities, it would be reported to the Nevada Division of Emergency Management, NDEP, BMRR, USEPA, National Response Center, BLM, and the Eureka or Elko County Emergency Response Coordinator.

In the event of a release en-route to the mine site, the transportation company would be responsible for response and cleanup. Law enforcement and fire protection agencies also may be involved to initially secure the site and protect public safety. Hazardous materials transporters are required to maintain an emergency response plan which details the appropriate response, treatment, and cleanup for a material spilled onto land or into water. For example, a release of hydrochloric acid could require neutralizing the spill with lime, flushing the area with water, or removing contaminated soil. Specific procedures would be developed for fuels, acids, and other hazardous materials. Any cleanup would be followed by appropriate restoration of the disturbed area, which could include replacing removed soil, seeding the area to prevent erosion, and the return of the land to its previous use.

3.14.2.3 Bazza Waste Rock Facility Alternative

There would be differences in hazardous materials use under the Bazza Waste Rock Facility Alternative, but solid waste generation and disposal is expected to be the same as compared to the Proposed Action. The Bazza Waste Rock Facility Alternative would require five additional haul trucks and result in consumption of an additional 5.3 million gallons of diesel fuel. There would be a very slight increase in the probability of a spill occurring during transportation of additional diesel fuel to the mine, but given the already low probability of a release, potential risk for impacts due to spills would be the same as for the No Action and Proposed Action.

3.14.3 Cumulative Impacts

The CESA for hazardous materials encompasses the permitted mine sites in the Carlin Trend (**Figure 3.1-2**). The past and present actions and RFFAs are identified in Section 3.1.

3.14.3.1 No Action

Quantities of hazardous materials transported and used and solid waste generated in the CESA are not expected to change appreciably in the future other than slight incremental increases (BLM 2007b,c). Quantities would be expected to decrease over the long term assuming the mineral deposits become completed and no new major mining takes place. Based on the foregoing and the fact that the likelihood of potential impacts is very remote, there would be no cumulative impacts.

3.14.3.2 Proposed Action

There would be no incremental annual increase in the use of hazardous materials or generation of solid waste, only an extension of the period of usage and generation. As with the No Action, there is a very low probability for potential impacts and consequently no cumulative impacts.

3.14.3.3 Bazza Waste Rock Facility Alternative

Potential cumulative effects under the Bazza Waste Rock Facility Alternative would be similar to the Proposed Action.

3.14.4 Mitigation Measures and Monitoring

Due to the legal framework that regulates the transportation, storage, use, and disposal of hazardous materials, no monitoring or mitigation measures have been identified.

3.14.5 Residual Impacts

Residual adverse effects from the use of hazardous materials under the Proposed Action would depend on the substance, quantity, timing, location, and response involved in the event of an accidental spill or release. Operation in accordance with the facility's SPCC Plan and the Environmental Incident Response Manual, and prompt cleanup of potential spills and releases, would minimize the potential of residual adverse effects due to accidental spills or releases of hazardous materials. Reagents such as sodium cyanide can be acutely toxic, but they do not persist in the environment for long periods of time. Modern regulations that govern the transportation, storage, use, and disposal of hazardous materials have greatly reduced the potential for residual adverse effects due to hazardous materials.

3.15 Energy Requirements

The estimated fuel and electrical power consumption for the Proposed Action and alternatives are provided in **Table 3.15-1**. Barrick Gold Corporation has adopted a Climate Change program, which is applicable to BGMI and includes a commitment to improve energy efficiency by 8 percent from its 2006 baseline model by 2012. In accordance with Nevada law, 15 percent of the electrical power consumed by BGMI would come from renewable energy sources. These reductions are not reflected below.

Recent scientific evidence suggests there is a direct correlation between global warming and emissions of GHG (IPCC 2007). GHGs include CO_2, methane, NO_X, and O_3. Although many of these gases occur naturally in the atmosphere, man-made sources have substantially increased the emissions of GHGs over the past several decades. Of the man-made GHGs, the greatest contribution currently comes from CO_2 emissions.

At present, there is no regulatory program which requires reductions in greenhouse emissions. However, in response to a Supreme Court decision interpreting the CAA, USEPA has announced that it will soon publish an advance notice of proposed rulemaking addressing regulatory mechanisms for regulating GHG emissions for purposes of addressing climate change. Congress also is debating legislation that would impose regulatory controls or incentives for reducing GHG emissions.

GHG emissions associated with the proposed project would be associated primarily with the consumption of energy for mining and ore processing over the 23-year project life. Operations that would contribute to GHG emissions would include:

- Fuel consumption (vehicles and machinery); and
- Electricity consumption (machinery, milling, dewatering).

The current national annual emissions of GHGs are approximately 8 billion tons (USEPA 2008). Under the Proposed Action, the project would emit approximately 972,594 tons per year of GHGs, or approximately 0.01 percent of the national annual emissions.

CO_2 Emissions

The Proposed Action would not change the present annual emission rate of CO_2 at the mine; however, it would extend the period of mining by 4 years over the No Action Alternative and generate 5 more years of CO_2 emissions. This extension of CO_2 emissions would not materially impact state, national, or global climate change.

Table 3.15-1 BGMI Estimated Fuel and Electrical Power Consumption

Case	Diesel Consumption (gallons)	Diesel Consumption (m^3)	Propane Consumption (gallons)	Propane Consumption (m^3)	Power Consumption (MW-hour)	Diesel-related GHG (tons)	Propane-related GHG (tons)			Indirect Power-related GHG (tons)			Green House Gas (tons)	GHG/Yr (tons)
						CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2		
No Action Alternative	49,990,211	189,268	1,025,450	3,882	18,884,232	569,404	27	17	6,418	0	0	19,152,367	19,728,234	1,096,013
Proposed Alternative	116,643,725	441,625	1,305,627	4,943	20,738,316	1,328,610	63	39	8,171	0	1	21,032,777	22,369,662	972,594
Bazza Waste Rock Facility Alternative	119,293,825	451,658	1,305,627	4943	20,738,316	1,358,795	65	40	8,171	0	1	21,032,777	22,399,848	973,906

Source: BGMI 2008a.

3.16 Relationship between Short-term Uses of the Human Environment and the Maintenance and Enhancement of Long-term Productivity

As described in the introduction to Chapter 3.0, short-term is defined as the 19-year operational life of the project and the 4-year reclamation period; long-term is defined as the future following reclamation (i.e., beyond 23 years). This section identifies the tradeoffs between the short-term impacts to environmental resources during operation and reclamation versus the long-term impacts to resource productivity that would extend beyond the end of reclamation.

The short-term use of resources during the expansion, operation, and reclamation of the proposed project would result in beneficial impacts in the form of an extension of local employment and the generation of revenue.

The proposed project would result in various short-term adverse impacts, such as the temporary loss of soil and vegetation productivity and the associated loss of wildlife habitat, possible wildlife avoidance and displacement, and temporary increases in fugitive dust. These impacts are expected to end upon completion of operations and would be minimized through implementation of applicant committed environmental protection measures.

The short-term adverse visual impacts would last a few years beyond mine closure and gradually would be reduced as vegetation becomes more established. The scale and extent of the facilities would continue to alter the local landscape and views in the long term.

Impacts to long-term productivity (i.e., following project reclamation) primarily would depend on the effectiveness of the proposed reclamation of the disturbance areas. Successful reclamation would provide for post-mining wildlife and self-sustaining plant communities. Revegetation also is expected to stabilize disturbed surfaces and control erosion.

There would be a long-term loss in soil and vegetation productivity and associated terrestrial wildlife habitat that would not be reclaimed.

3.16 Relationship between Short-term Uses of the Human Environment and the Maintenance and Enhancement of Long-term Productivity

3.17 Irreversible and Irretrievable Commitment of Resources

The Proposed Action could result in the irreversible commitment of resources (e.g., the loss of future options for resource development or management, especially of nonrenewable resources such as minerals or cultural resources) or the irretrievable commitment of resources (e.g., the lost production or use of renewable natural resources during the life of the operations). Irreversible and irretrievable impacts of the Proposed Action are summarized for each resource in **Table 3.17-1**.

Table 3.17-1 Irreversible and Irretrievable Commitment of Resources by the Proposed Action

Resource	Irreversible Impacts	Irretrievable Impacts	Explanation
Geology and Minerals	Yes	Yes	Approximately 12.44 million tons of gold ore would be mined during operations. This would result in the irreversible and irretrievable commitment of this resource.
Groundwater Resources and Geochemistry	Yes	Yes	Evaporation from the pit lake is an irreversible and irretrievable impact.
Surface Water Resources	No	No	No irreversible or irretrievable commitment of resources or impact is anticipated.
Soils	Yes	Yes	Suitable growth media would be salvaged from the mine disturbance areas for use in reclamation. There would be a loss of soil productivity during operations on approximately 1,051 acres, resulting in an irretrievable commitment of this resource. There would be an additional irreversible commitment of the resource on approximately 129 acres associated with the Betze Pit expansion, which would not be reclaimed.
Vegetation	Yes	Yes	There would be an irretrievable commitment of vegetation resources on approximately 1,180 acres during operations. Vegetation subsequently would be re-established on all areas except approximately 129 acres that would be irreversibly lost as a result of development of the Betze Pit expansion.
Wildlife and Aquatic Resources	Yes	Yes	Approximately 1,180 acres of habitat would be irretrievably lost until vegetation has re-established following reclamation. Approximately 129 acres of the total habitat disturbance would be irreversibly lost for wildlife species as a result of development of the Betze Pit expansion. Approximately 2.3 miles of intermittent stream habitat in Rodeo Creek would be removed. A new section of Rodeo Creek would be constructed and potentially routed to the pit lake.
Cultural Resources	Yes	Yes	Although data recovery has been conducted at five historic properties, irreversible and irretrievable impacts to these sites would occur because the sites ultimately would be destroyed by project construction and some of their data would be lost. Irreversible and irretrievable indirect and cumulative impacts to sites not undergoing data recovery would occur.
Native American Traditional Values	No	No	No TCP or place of cultural or religious importance has been identified through inventory or by the contacted tribes.
Air Quality	No	No	Project emissions would not exceed federal or state AAQS. Air quality would return to existing conditions after completion of the project.
Social and Economic Values	No	Yes	Labor and some capital resources, once committed and expended, would not be retrievable.
Visual Resources	Yes	No	Impacts to visual resources would be reduced through successful reclamation procedures and implementation of the environmental protection measures. However, permanent changes would result.
Hazardous Materials and Solid Waste	No	No	No irreversible or irretrievable commitment of resources or impact is anticipated. However, if a spill were to affect a sensitive resource, an irretrievable impact could occur pending the recovery of the resource.

PUBLIC CONSULTATION AND COORDINATION

CHAPTER 4

4.0 Public Consultation and Coordination

4.1 Public Participation

4.1.1 Scoping

A Notice of Intent to prepare a SEIS was published in the FR on May 29, 2007 (FR Volume 72, Number 102). A public scoping meeting for the SEIS was held in Elko, Nevada, on June 25, 2007. The comments received during the scoping process were considered in developing this SEIS. The BLM Elko District Office issued a press release on June 3, 2007, announcing the public scoping meeting. The press release was distributed electronically to Congressional office staff, local government entities (city/county), federal and state agencies, and various media outlets throughout the proposed project area). The public meeting announcement was published on June 23, 2007, in the Elko Daily Free Press.

A scoping letter was mailed on May 25, 2007, notifying individuals on the Elko District Office mailing list of BLM's intent to prepare a SEIS. The letter included the project description, information about the scoping meeting (date, time, and location) and BLM contact information.

The public scoping meeting at the BLM Elko District Office was conducted in an open house format. Attendees were provided information about the project and given an opportunity to ask resource specialists and BLM representatives questions, as well as express their concerns about the project. Applicant representatives were available to assist in answering specific questions regarding the proposed project. Display boards presented information about the proposed project disturbance, project expansion layout (schematic), and wildlife corridors; a fact sheet was available that highlighted specific project information. Additionally, a continuous-running computer-generated presentation was available for public viewing. Five agency personnel representing the BLM and NDOW, and one member of the public attended the scoping meeting (the "member of the public" was actually a representative from the Elko County Commissioner's office and later became a cooperator in the SEIS process).

The BLM received a total of 10 comment submittals (e.g., letter, email) containing 80 individual comments during the scoping period. Most of the comments came from government agencies and nongovernmental organizations. Scoping comments were used to help determine the scope of issues to be addressed and to help identify the significant issues related to a proposed action (40 CFR 1501.7). The Public Scoping Comment Summary Report prepared for this SEIS (BLM 2008b) provides a detailed table listing each individual comment, its location in the original scoping submittal, BLM's determination of the comment, and where the comment will be addressed in the SEIS. **Table 4-1** describes the distribution of scoping comments by organization.

4.1.2 Public Review of the Draft SEIS

The Draft SEIS will be available for a 45-day public review and comment period from the date the Notice of Availability is published in the *Federal Register*. All who provided scoping input will receive a paper copy of the SEIS or will have access to the document on the BLM Nevada website at www.blm.gov/nv, on the Elko District Office NEPA webpage.

4.2 Consultation and Coordination with Federal, State and Local Agencies, and Tribes

Issues related to agency consultation and/or review include mining regulation and reclamation, biological resources, cultural resources, socioeconomics, and land and water management. Cultural resource consultations apply to the potential for impacts to important historic, archaeological or traditional sites important to Native Americans; however, a Programmatic Agreement among the BLM, Nevada SHPO, and

Table 4-1 Scoping Comments Distribution

Organization Name	Total Number of Comments
Western Watersheds Project	26
Elko County Board of Commissioners	4
Private Citizens (2)	4
Centerra (U.S.), Inc.	1
Humboldt River Basin Water Authority	1
Department of the Interior, USFWS	6
USEPA	16
Nevada State Historic Preservation Office	1
Nevada Division of State Lands	5
Great Basin Resource Watch	32

Advisory Council on Historic Preservation was developed for the previous EIS and included future project expansion. BLM and SHPO consulted and concurred on the data recovery plan.

The USFWS engaged in discussions with BLM and ENSR regarding the threatened, endangered, and sensitive species. They also provided comments on the Betze Pit Lake ERA. The USEPA provided comments on the Betze Pit Lake ERA and expressed concern about potential soil salinization in the Boulder Valley after dewatering ceases at the end of mining. It was clarified in the text of the SEIS that Newmont owns the water rights and plans to continue irrigation in the Boulder Valley. USEPA also provided information on the air quality input analysis, and the mercury emissions modeling in particular.

As the state agency with jurisdiction and special expertise related to impacts on wildlife, the NDOW has agreed to participate as a cooperating agency in the preparation of this SEIS. NDOW provided mule deer migration corridor information as well as sage-grouse, mule deer, and antelope use areas for CESA designation.

In addition, the Elko County Commissioner also agreed to participate as a cooperating agency to review an analysis of the socioeconomic impact of mining on the county. Other local agencies that provided information for the socioeconomic impacts were the:

- Eureka County Assessor;
- Elko County;
- City of Elko; and
- City of Carlin.

The following Tribes and Tribal organizations were contacted by letter for the proposed project and are listed in the SEIS Distribution List in Section 4.3.

Te-Moak Tribe of Western Shoshone
Ely Shoshone Tribe
Duck Valley Sho-Pai Tribes of Idaho/Nevada
Wells Band Council
Elko Band Council
Duckwater Shoshone Tribe
Yomba Shoshone Tribe
Battle Mountain Band Council
South Fork Band Council
Western Shoshone Committee of Duck Valley

4.3 SEIS Distribution List

Federal Agencies

BLM; Battle Mountain District Office
BLM; Carson City District Office
BLM; Ely District Office
BLM; Las Vegas District Office
BLM; Nevada State Office
BLM; Washington, DC Office
BLM; Winnemucca District Office
Library of Congress; Washington, DC
Office of Public Affairs; Washington, DC
U.S. Department of Energy; Office of Environmental Compliance; Washington, DC
U.S. Department of the Interior; Office of Environmental Policy and Compliance; Washington, DC
U.S. Department of the Interior; Natural Resources Library; Washington, DC
USEPA; Office of Federal Activities; San Francisco, CA
USEPA; Office of Federal Activities; Washington, DC
USEPA, Arlington; VA
U.S. Fish and Wildlife Service; CA/NV Operations Office
U.S. Fish and Wildlife Service; Reno, NV
USGS; Reston, VA

State Agencies

Humboldt River Basin Water Authority
Nevada Department of Wildlife (Elko, Nevada)
Nevada Division of Environmental Protection; Bureau of Mining Regulation and Reclamation
Nevada State Clearing House
Nevada State Historic Preservation Office

Elected Officials

Ensign, John; U.S. Senator
Gibbons, Jim; Governor
Goicoechea, Pete; Assemblyman
Marvel, John; Assemblyman
Reid, Harry; U.S. Senator
Rhoads, Dean A; State Senator

County and Local Agencies

Elko County Board of Commissioners
Elko County Manager
Eureka County Commissioners
Eureka County Department of Natural Resources

Tribal Organizations

Battle Mountain Band Council
Duck Valley Sho-Pai Tribes of Idaho/Nevada
Elko Band Council
Te-Moak Tribal Council
Wells Band Council

Newspapers and Libraries

Elko Daily Free Press
University of Nevada Libraries, Business and Government Information Center
University of Nevada Libraries, DeLaMare Library

Organizations

Great Basin Resource Watch
Western Mining Action Project
Western Watersheds Project

Industry/Business

Barrick Goldstrike Mines, Inc.
Bullion Monarch Mining
Cedar Creek Associates
Centerra (U.S.) Inc.
JBR Environmental Consultants
Nevada Mining Association
Newmont Mining Co.
Parsons, Behle, and Latimer
PJH Environmental Inc.
Royal Gold
Schafer Limited

Individuals

Armstrong-Nelson, Joe
Dubois, Mark
Laravie, Joseph A.
Michna, Robert
Paulsen, Kenneth R.
Sachau, B.

LIST OF PREPARERS AND REVIEWERS

CHAPTER 5

5.0 List of Preparers and Reviewers

5.1 Bureau of Land Management EIS Team

Responsibility	Name	Degree(s) and Experience
BLM Project Manager; Geology and Minerals; Groundwater Quantity; Socioeconomics	Kirk Laird	B.S. Geology B.S. Oceanography MBA 16 years experience
NEPA Coordinator	Lorrie West	B.S. Soil and Water Resources 30 years experience
Cultural Resources	Bill Fawcett	B.A. Anthropology M.A. Anthropology Ph.D. Anthropology 30 years experience
Visual Resources	Steve Dondero	B.S. Wildlife Management Minors in Range and Biology 30 years experience
Surface Water Quantity and Quality; Groundwater Quality; Soils; Air Quality	Mark Dean	B.S. Watershed and Earth Systems 4 years experience
Native American Religious Concerns	Gerald Dixon	B.S. Cultural Anthropology 12 years experience
Wildlife Resources, T&E Species; Vegetation; Riparian and Wetlands; Aquatic Resources	Nycole Burton	B.S. Zoology M.S. Animal Science M.S. Natural Resources 8 years experience
Cooperating Agency – Nevada Department of Wildlife		**Degree(s) and Experience**
Rory Lamp		B.S. Zoology 27 years experience
Katie Miller		B.S. Wildlife Resources M.S. Biology 5 years experience
Cooperating Agency – Elko County Commissioner		
Sheri Eklund-Brown		County Commissioner B.A. Recreation Management 5 years experience

5.2 ENSR EIS Team (Third-party Consultant)

Responsibility	Name	Degree(s) and Experience
Project Initiation, Project Management, SEIS Preparation Plan, Draft SEIS Preparation, Final SEIS Preparation	Scott Duncan	M.S. Biology B.A. Biology 23 years experience
SEIS Preparation Plan, NEPA Document Coordinator, Draft SEIS Preparation, Final SEIS Preparation, Project Management	Anne Doud	M.S. Ecology B.A. Biology 9 years experience
Senior NEPA Reviewer	Valerie Randall	B.A. Urban Studies 29 years experience
Public Participation	Peggy Roberts	B.A. Journalism/Public Relations M.S. Journalism and Technical Communications 9 years experience
Wildlife (including special status species)	Charles Johnson	M.S. Biology B.S. Wildlife Biology 15 years experience
	Matt Brekke	B.S. Wildlife Biology 2 years experience
Aquatic Resources	Rollin Daggett	M.S. Marine Biology B.S. Zoology 32 years experience
Vegetation (including special status species), Invasive Nonnative Plant Species, Riparian and Wetlands	Allie Grow	B.S. Rangeland Ecosystem Science B.S. Soil and Crop Science 3 years experience
Groundwater	Robert Berry	Ph.D. Geology and Geochemistry M.S. Geology B.S. Geology 27 years experience
Soils, Reclamation	Terra Mascarenas	B.S. Soil and Crop Science 10 years experience
Watersheds, Surface Water	Jim Burrell	B.S. Forest Management M.S. Civil Engineering 29 years experience
Geology and Minerals, Hazardous and Solid Wastes, Paleontological Resources	William Berg	M.S. Geology B.S. Geology 26 years experience
Cultural Resources, Native American Traditional Values	Kim Munson	M.A. Anthropology B.A. Anthropology 13 years experience

Responsibility	Name	Degree(s) and Experience
Air Quality	Vince Scheetz	M.S. Systems Management B.S. Mathematics 37 years experience
Social and Economic Values	Bernie Strom	M.C.R.P. City and Regional Planning B.S. Urban Planning 32 years experience
Visual Resources	Merlyn Paulson	M.L.A. Landscape Architecture B.L.A. Landscape Architecture and Environmental Planning 33 years experience
GIS/Graphics Preparation	Scott Mackinnon	B.S. Physical Geography 4 years experience
Document Production	Ruth Idler	21 years experience

5.3 Barrick Goldstrike Mine Reviewers

Name	Title and Company
Joe Giraudo	Environmental Superintendent, Barrick Goldstrike Mines
Andy Cole	Environmental Manager, Barrick Goldstrike Mines
Steve Schoen	Manager of Permitting, Barrick Gold North America
Ted Grandy	Attorney, Barrick Gold North America
Rich Haddock	Regional Counsel, Barrick Gold North America
Jim Butler	Attorney, Parsons Behle & Latimer
Elizabeth Schulte	Attorney, Parsons Behle & Latimer

REFERENCES, ACRONYMS AND ABBREVIATIONS, GLOSSARY, AND INDEX

CHAPTER 6

6.0 References, Acronyms and Abbreviations, Glossary, and Index

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6.2 Acronyms and Abbreviations

°F	degrees Fahrenheit
µg/L	microgram per liter
µg/m^3	microgram per cubic meter
AAQS	Ambient Air Quality Standards
AATA	AATA International, Inc.
ABA	acid-base accounting
ACHP	Advisory Council on Historic Preservation
afy	acre-feet per year
AGP	acid generation potential
AIRFA	American Indian Religious Freedom Act
amsl	above mean sea level
ANP	acid neutralization potential
APE	area of potential effect
ARD	acid rock drainage
ARPA	Archaeological Resources Protection Act
BAPC	Bureau of Air Pollution Control
BGMI	Barrick Goldstrike Mines Inc.
BLM	Bureau of Land Management
BMP	Best Management Practice
BMRR	Bureau of Mining Regulation and Reclamation
BVMP	Boulder Valley Monitoring Plan
CAA	Federal Clean Air Act
CAAA	Federal Clean Air Act Amendments
$CaCO_3$	Calcium carbonate
CAT	Computerized Axial Tomography
CDP	Census Designated Place

CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	Cumulative Effects Study Area
CFR	CFR
cfs	cubic feet per second
CH_3Hg^+	methyl mercury
CIA	Cumulative Impact Analysis of Dewatering and Water Management Operations for the Betze Project, South Operations Area Project Amendment, and Leeville Project
CIL	carbon-in-leach
cm	centimeter
cm/sec	centimeter per second
CN	cyanide
CO	carbon monoxide
CO_2	carbon dioxide
COPC	constituent of potential concern
CWA	Clean Water Act
DRI	Desert Research Institute
EA	Environmental Assessment
EC	electrical conductivity
ECEDA	Elko County Economic Diversification Authority
EIS	Environmental Impact Statement
ELLCO	Elko Land and Livestock Company
EO	Executive Order
EMA	Environmental Management Associates, Inc.
ERA	ecological risk assessment
ESA	Endangered Species Act
ET	Evapotranspiration

FLPMA	Federal Land Policy and Management Act
FR	Federal Register
FSA	Fire Science Academy
FY	fiscal year
GBC	Great Basin College
g/km^2-yr	grams per square kilometer per year
g/m^2	grams per square meter
GHG	Greenhouse Gas
gpm	gallons per minute
HAP	Hazardous Air Pollutant
HDPE	high density polyethylene
Hg	mercury
HQ	Hazard Quotient
I-80	Interstate 80
ICMC	International Cyanide Management Code
ICU	Intensive Care Unit
IM	Instructional Memorandum
INCO	International Nickel Company
JBR	JBR Environmental Consultants, Inc.
Kg/t $CaCO_3$	kilograms per ton of calcium carbonate
KOP	Key Observation Point
kV	Kilovolt
km	Kilometer
LCT	Lahontan cutthroat trout
LLDPE	linear low density polyethylene
m	meter
mg/L	milligrams per liter

MBTA	Migratory Bird Treaty Act
MCBMP	Maggie Creek Basin Monitoring Plan
mgd	million gallons per day
MOU	Memorandum of Understanding
MPR	Mountain Prairie Region
MRI	Magnetic Resonance Imaging
MSHA	Mine Safety and Health Administration
MUID	Map Unit Identification
NAAQS	National Ambient Air Quality Standards
NAC	Nevada Administrative Code
NAG	non-acid generating
NAGPRA	Native American Graves Protection and Repatriation Act
NDEP	Nevada Division of Environmental Protection
NDETR	Nevada Department of Employment, Training, Rehabilitation
NDOW	Nevada Department of Wildlife
NDWR	Nevada Division of Water Resources
NEPA	National Environmental Policy Act
Newmont	Newmont Mining Corporation
NHPA	NHPA of 1986
NMCP	Nevada Mercury Air Emissions Control Program
NNHP	Nevada Natural Heritage Program
NNP	net neutralization potential
NNSG	Northeastern Nevada Stewardship Group
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NPS	National Park Service
NRCS	Natural Resources Conservation Service

NRHP	National Register of Historic Places
NRS	Nevada Revised Statute
NSHD	Nevada State Health Division
NSPS	New Source Performance Standards
NVMACT	Nevada Maximum Achievable Control Technology
NWR	National Wildlife Refuge
O_3	Ozone
PA	Programmatic Agreement
PAG	potentially acid generating
PCPI	Per Capita Personal Income
PCS	Petroleum Contaminated Soil
PLS	Pure Live Seed
PM	particulate matter
PM_{10}	particulate matter with an aerodynamic diameter of 10 microns or less
$PM_{2.5}$	particulate matter with an aerodynamic diameter of 2.5 microns or less
PMF	probable maximum flood
POO	Plan of Operations
ppm	parts per million
PSD	Prevention of Significant Deterioration
RCP	reinforced concrete pipe
RCRA	Resource Conservation and Recovery Act
REMSAD	Regional Modeling System for Aerosols and Depostion
RFFA	Reasonably Foreseeable Future Action
RIB	Rapid Infiltration Basin
RMP	Resource Management Plan
ROD	Record of Decision
ROM	Run of Mine

ROW	right-of-way
RSD	Recommended Salvage Depth
RTi	Riverside Technology inc.
RV	Recreational Vehicle
SARA	Superfund Amendments and Reauthorization Act
SEIS	Supplemental Environmental Impact Statement
SH	State Highway
SHPO	State Historic Preservation Office
SIP	State Implementation Plan
SO_2	sulfur dioxide
SOAP	South Operations Area Project
SOAPA	South Operations Area Project Amendment
SPCC Plan	Spill Prevention, Control, and Countermeasures Plan
SR	State Route
SRK	SRK Consulting
SSURGO	Soil Survey Geographic Database
SU	standard units
SWCA	SWCA Environmental Consultants Inc.
SWPPP	Storm Water Pollution Prevention Plan
SWReGAP	Southwest Regional GAP
TCP	traditional cultural property
TDS	total dissolved solids
t/Kt	tons per kiloton
tpy	tons per year
TRI	toxic release inventory
TRV	toxicity reference values
USACE	United States Army Corps of Engineers

USC	United States Code
USDA	United States Department of Agriculture
USDOT	United States Department of Transportation
USEPA	United States Environmental Protection Agency
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	U.S. Geological Survey
UWCHEP	Upper Willow Creek Habitat Enhancement Plan
VOC	Volatile Organic Compound
VRM	Visual Resource Management
WAD	weak acid dissociable
WAPT	Wildlife Action Plan Team
WEPP	Water Erosion Prediction Project
WNV	West Nile Virus
WMA	Wildlife Management Area

6.3 Glossary

Adverse Effect (under the NHPA)	An adverse effect is found when an undertaking may alter, directly or indirectly, any of the characteristics of a historic property that qualify the property for inclusion in the NRHP in a manner that would diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association.
Alluvial	Pertaining to material or processes associated with transportation or deposition of soil and rock by flowing water (e.g., streams and rivers).
Alluvium	Unconsolidated or poorly consolidated gravel, sands, and clays deposited by streams and rivers on riverbeds, floodplains, and alluvial fans.
Ambient	The environment as it exists at the point of measurement and against which changes or impacts are measured.
American Indian Religious	Act establishing national policy to protect and preserve for Native Americans their inherent right of freedom to believe, express, and exercise their traditional religions, including the rights of access to religious sites, use and possession of sacred objects, and freedom to worship through traditional ceremonies and rites.
Archaeological Resources	A federal law, passed in 1979 to protect archaeological resources on public and Indian lands.
Area of Potential Effects	Defined in Section 106 regulations as the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist.
Aquifer	A body of rock that is sufficiently permeable to conduct groundwater and to yield economically significant quantities of water to wells and springs.
Background Noise	Noise from all sources other than that from a particular source of interest (e.g., other than mining noise if mining noise were being investigated).
Bedrock	Any solid rock exposed at the surface or overlain by unconsolidated material.
BLM Sensitive Species	Previous Category 2 (C2) candidate species.
CFR	The compilation of federal regulations adopted by federal agencies through a rule-making process.
Carrying Capacity	The maximum population of an animal that an ecosystem can support without being degraded.

Cone of Depression	The depression of groundwater levels around a pumping well caused by the withdrawal of water.
Critical Habitat	Habitat that is present in minimum amounts and is the determining factor in the potential for population maintenance and growth.
Cultural Resources	Archaeological sites, architectural structures or features, traditional use areas, and Native American sacred sites or special use areas.
Cumulative Effects	The combined environmental impacts that accrue over time and space from a series of similar or related individual actions, contaminants, or projects. Although each action may seem to have a negligible impact, the combined effect can be significant. Included are activities of the past, present, and reasonably foreseeable future; synonymous with cumulative impacts.
Direct Impacts	Impacts that are caused by the action and occur at the same time and place (40 CFR 1508.7); synonymous with direct effects.
Discharge	The volume of water flowing past a point per unit time, commonly expressed as cubic feet per second, gallons per minute, or million gallons per day.
Disturbed Area	An area where natural vegetation and soils have been removed.
Dolomite	A mineral, calcium magnesium carbonate ($CaMg[CO_3]_2$), or a rock composed largely of dolomite.
Drainage	The natural channel through which water flows some time of the year; natural and artificial means for affecting discharge of water as by a system of surface and subsurface passages.
Drawdown	The lowering of the water level in a well as a result of withdrawal; the reduction in groundwater level at a point caused by the withdrawal of water from an aquifer.
Effect	An effect on one of the characteristics that may make a historic property eligible for inclusion in the NRHP.
Endangered Species	Any species in danger of extinction throughout all or a significant portion of its range. Plant or animal species identified by the Secretary of the Interior as endangered in accordance with the 1973 ESA.
Ephemeral Stream	A stream or portion of a stream that flows briefly in direct response to precipitation in the immediate vicinity and whose channel is at all times above the water table.
Erosion	The wearing away of soil and rock by weathering, mass wasting, and the action of streams, glaciers, waves, wind, and groundwater.
Executive Order 11593	Requires federal agencies to survey properties under their jurisdiction and nominate appropriate candidates to the NRHP.

Executive Order 13287 of 2003	Initiative affirming the federal government's leadership role in protecting historic properties. Among the goals of Preserve America are to promote partnerships for the use and rehabilitation of historic properties, and to assist in developing heritage tourism opportunities.
Exploration	The search for economic deposits of minerals, ore, and other materials through practices of geology, geochemistry, geophysics, drilling, and/or mapping.
Fault	A fracture in rock units along which there has been displacement.
Floodplain	That portion of a river valley, adjacent to the channel, that is built of sediments deposited during the present regimen of the stream and that is covered with water when the river overflows its banks at flood stages.
Fugitive Dust	Dust particles suspended randomly in the air from various sources including road travel, excavation, and rock loading operations.
Geochemistry	The study of the distribution and amounts of the chemical elements in minerals, ores, rocks, soils, water, and the atmosphere, and their circulation in nature on the basis of the properties of their atoms and ions.
Geotechnical	A branch of engineering concerned with the engineering design aspects of slope stability, settlement, earth pressures, bearing capacity, seepage control, and erosion.
Groundwater Recovery	An increase in groundwater levels such that the groundwater elevations rise above initial baseline groundwater elevations. Used to refer to an increase in water levels following drawdown.
Groundwater Table	The surface between the zone of saturation and the zone of aeration; that surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere.
Habitat	A specific set of physical conditions that surround a single species, a group of species, or a large community. In wildlife management, the major components of habitat are considered to be food, water, cover, and living space.
Hazard Quotient	A comparison of an estimated chemical intake (dose) with a reference dose level below which adverse health effects are unlikely. The hazard quotient is expressed as the ratio of the estimated intake to the reference dose. The value is used to evaluate the potential for noncancer health effects, such as organ damage, from chemical exposures.
Heap Leaching	The process of recovering gold and other metals from low-grade ores by leaching ore that has been mined and placed on a specially prepared pad. A chemical solution is applied through low volume emitters, and the metal-bearing leachate solution percolates and is collected.

Historic Property	Defined by the NHPA as any property included in or eligible for the NRHP.
Hydraulic Conductivity	The capacity of a rock to transmit water. It is expressed as the volume of water at the existing kinematic viscosity that will move in unit time under a unit hydraulic gradient through a unit area measured at right angles to the direction of flow.
Hydrostratigraphic Unit	Grouping of stratified, mainly sedimentary rocks that have similar hydrologic properties.
Impact	A modification in the status of the environment brought about by the Proposed Action or an alternative.
Indirect Impacts	Impacts that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable (40 CFR 1508.8); synonymous with indirect effects.
Infiltration	The movement of water or some other liquid into the soil or rock through pores or other openings.
Irretrievable	Applies primarily to the lost production of renewable natural resources during the life of the project.
Irreversible	Applies primarily to the use of nonrenewable resources, such as minerals, cultural resources, wetlands, or to those factors that are renewable only over long time spans, such as soil productivity. Irreversible also includes loss of future options.
Jurisdictional Wetland	A wetland area identified and delineated by specific technical criteria, field indicators, and other information for purposes of public agency jurisdiction. The public agencies that administer jurisdictional wetlands are the USACE, the USEPA, the USFWS, and the NRCS.
Key Observation Point	"One or a series of points on a travel route or at a use area or a potential use area, where the view of a management activity would be most revealing" (BLM 1986c). KOPs are commonly selected to represent the most sensitive viewpoints for a proposed management activity based on the number of people who would experience them or the frequency and duration of viewing.
Leachate	A solution obtained by leaching as in downward percolation of water through soil or waste.
Mineralization	The process by which a valuable mineral or minerals are introduced into a rock.
Mitigate, Mitigation	To cause to become less severe or harmful; actions to avoid, minimize, rectify, reduce or eliminate, and compensate for impacts to environmental resources.

Monitor	To systematically and repeatedly watch, observe, or measure environmental conditions in order to track changes.
National Environmental Policy Act	The National Environmental Policy Act (NEPA) of 1969; the national Policy charter for protecting the environment. NEPA establishes policy, sets goals, and provides means for carrying out the policy. Regulations from 40 CFR 1500-1508 implement the act.
National Historic Preservation	Act directing federal agencies to consider the effects of their programs and projects on properties listed on or eligible for the NRHP. If a proposed action might impact any archaeological, historical, or architectural resource, this act mandates consultation with the proper agencies.
National Pollutant Discharge Elimination System	A part of the Clean Water Act that requires point source dischargers to obtain permits. These permits are referred to as NPDES permits and are administered by the USEPA.
National Register of Historic Places	A register maintained by the NPS that lists districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, engineering and culture that meet criteria set forth in 36 CFR 60.
Native American Grave Protection and Repatriation Act of 1990	A federal law, passed in 1990 that provides for the return of certain sacred and ceremonial objects held by museums and other repositories to the Native American peoples from which they were originally acquired.
Native Species	Plants that originated in the area in which they are found (i.e., they naturally occur in that area).
Nevada Administrative Code	The text of the regulations implementing the laws passed by the Nevada legislature.
Nevada Revised Statutes	The text of laws passed by the Nevada legislature.
Ore	A deposit of rock from which a valuable mineral or minerals can be economically extracted.
Overburden	Material that must be removed to allow access to an orebody, particularly in a surface mining operation.
Paleozoic	The span of time between approximately 570 and 245 million years ago.
Particulate(s)	Minute, separate particles, such as dust or other air pollutants.
Perennial Stream	A stream or reach of a stream that flows throughout the year.
Physiographic Province	Region in which all parts have similar geologic structure and climate and whose landforms differ significantly from those of other regions.

Project Alternatives	Alternatives to the Proposed Action developed through the NEPA process.
Properties of Cultural and Religious Importance	A "property of cultural or religious importance" that is a historic property eligible for the NRHP and associated with the cultural practices of an Indian tribe or other cultural or ethnic community.
Raptor	A bird of prey (e.g., eagle, hawk, falcon, and owl).
Recovery (Groundwater)	An increase in groundwater levels such that the groundwater elevations rise above initial baseline groundwater elevations. Refers to an increase in water levels following drawdown.
Reserves	Identified resources of mineral-bearing rock from which the mineral can be extracted profitably with existing technology and under present economic conditions.
ROW	Strip of land or corridor over which a power line, access road, or maintenance road would pass.
Riparian	Situated on or pertaining to the bank of a river, stream, or other body of water. Riparian is normally used to refer to plants of all types that grow along streams, rivers, or at spring and seep sites.
Run-of-Mine Ore	Ore that is taken from a mine or pit directly to a mill for processing.
Runoff	That part of precipitation that appears in surface streams; precipitation that is not retained on the site where it falls and is not absorbed by the soil.
Sediment	Material suspended in or settling to the bottom of a liquid. Sediment input comes from natural sources, such as soil erosion and rock weathering, construction activities, or anthropogenic sources, such as forest or agricultural practices.
Sediment Load	The amount of sediment (sand, silt, and fine particles) carried by a stream or river.
Seismicity	The likelihood of an area being subject to earthquakes; the phenomenon of earth movements.
Sensitive Viewpoint	Similar to a KOP, but of lesser sensitivity due to infrequency of use, small numbers of viewers, or similar mitigating circumstances.
Species	A group of individuals of common ancestry that closely resemble each other structurally and physiologically, and in nature interbreed producing fertile offspring.
Stratigraphy	Form, arrangement, geographic distribution, chronological succession, classification, and relationships of rock strata.
Subsidence	Sinking or downward settling of the earth's surface.

Tertiary	The span of time between 65 and 10 million years ago.
Threatened Species	Any species of plant or animal that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.
Total Dissolved Solids	The total amount of dissolved material, organic or inorganic, contained in a sample of water.
Total Suspended Solids	The amount of undissolved particles suspended in a sample of water.
Traditional Cultural Property	A site or resource that is eligible for inclusion in the NRHP because of its association with cultural practices or beliefs of a living community.
Transmissivity	The rate at which water of the prevailing kinematic viscosity is transmitted through a unit width of an aquifer under a unit hydraulic gradient; it equals the hydraulic conductivity multiplied by the aquifer thickness.
Visual Resource	The composite of basic terrain, geologic features, water features, vegetation patterns, and land use effects that typify a land unit and influence the visual appeal the unit may have for viewers. A classification of landscapes according to the kinds of structures and changes that are acceptable to meet established visual goals (BLM).
Water Table	The level in the saturated zone at which the pressure is equal to the atmospheric pressure.
Waters of the United States	A jurisdictional term from Section 404 of the Clean Water Act referring to water bodies such as lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds. The use, degradation, or destruction of these waters could affect interstate or foreign commerce.
Wetlands	Areas that are inundated by surface or groundwater with a frequency sufficient to support (and under normal circumstances do or would support) a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.
Wind Rose	A graphical representation of wind direction and wind speed frequencies.

6.4 Index

Affected Environment 3.0-1, 3.2-1, 3.3-1, 3.4-1, 3.5-1, 3.6-1, 3.7-1

..... 3.8-1, 3.9-1, 3.10-1, 3.11-1, 3.12-1, 3.13-1, 3.14-1

Air Quality 3.11-1

Alternatives Considered but Eliminated 2-58

Ancillary Support Facilities 2-7

Bazza Waste Rock Facility Alternative 2-56, 3.2-8, 3.3-61, 3.4-11, 3.5-19, 3.5-21, 3.6-9

..... 3.7-13, 3.7-16, 3.8-27, 3.8-28, 3.9-6, 3.9.7, 3.10-4

.....3.11-14, 3.11-18. 3.12-13, 3.12-15, 3.13-7, 3.14-7, 3.14-8

Betze Pit Backfill 2-18, 2-36

BLM-preferred Alternative 2-61

Comparative Analysis of Alternatives 2-61

Cultural Resources 2-45, 2-63, 3.9-1

Cumulative Impacts 3.2-8, 3-4.12, 3.5-20, 3.6-9, 3.7-13, 3.8-29, 3.9-6,

.....3.10-4, 3.11-14, 3.12-14, 3.13-7, 3.14-1

Dewatering 2-8

Drilling and Blasting 2-6

Environmental Consequences 3.0-1, 3.2-5, 3.3-22, 3.4-6, 3.5-12, 3.6-6, 3.7-9,

.....3.8-14, 3.9-4, 3.10-4, 3.11-7, 3.12-10, 3.13-4, 3.14-4

Environmental Protection Measures 2-15, 2-43

Existing Facilities 2-17

Exploration 2-7

Fencing and Site Security 2-7

Fire Protection 2-8

Geochemistry 3.3-1

Geology and Minerals 3.2-1

Goldstrike No. 3 Tailings Facility 2-36, 3.3-61

Haul Road 2-33
Heap Leach Facilities 2-6
Infrastructure 2-6
Invasive and Non-native Species 2-44
Irreversible and Irretrievable Impacts 3.17-1
Irrigation 2-11
Meikle Mine 2-4
Mercury 3.11-5, 3.11-7, 3.11-10, 3.11-12, 3.11-14, 3.11-17
Mining Operations 2-4, 2-17, 2-32, 3.14-4
Mitigation Measures and Monitoring 3.2-9, 3.3-64, 3.4-14, 3.5-21, 3.6-9, 3.7-16
..... 3.8-36, 3.9-7, 3.10-6, 3.11-22, 3.12-15, 3.13-7, 3.14-8
Native American Consultation 3.10-2
Native American Traditional Values 3.10-1
No Action Alternative 2-2
Noise 3.8-15, 3.8-19
Noxious Weeds 3.7-6, 3.7-10, 3.7-12, 3.7-13, 3.7-14, 3.7-16
Past and Present Actions 3.1-2
Permits and Approvals 1-5
Pit Lake 3.3-23, 3.3-41
Proposed Action 2-29
Public Participation 4-1
Purpose and Need for Action 1-1
Reasonably Foreseeable Future Actions 3.1-7
Reclamation 3.5-1
Residual Impacts 3.2-9, 3.3-65, 3.4-14, 3.5-22, 3.6-10, 3.7-17,
..... 3.8-36, 3.9-7, 3.10-6, 3.11-12, 3.12-15, 3.13-8, 3.14-8,
Rodeo Creek Diversion 2-13, 3.3-27, 3.3-41, 3.3-57, 3.5-15

Rodeo Mine 2-4

Schedule and Work Force 2-17

Scoping 4-1

Social and Economic Values 3.12-1

Special Status Species 2-44, 3.6-2, 3.7-6, 3.8-6, 3.8-23, 3.8-27, 3.8-34, 3.8-35, 3.8-36

Tailings Facility 2-18, 2-36, 2-51, 2-61

Underground Mining 2-61

Waste Rock Geochemistry 3.3-14

Waste Rock Facilities 2-17, 2-33, 2-50, 2-56, 2-58

Water Management 2-8

Water Supply 2-7

CURRENT GOLDSTRIKE MINE PERMITS AND AUTHORIZATIONS

APPENDIX A

Table A-1 Current Goldstrike Mine Permits and Authorizations

Permit Title	Portion of Operation Covered by Permit	Agency	Period Covered
Programmatic Agreement Regarding the Treatment of Historic Properties	Operation Area	BLM NDHPA Advisory Council on Historic Preservation	1991 to 2011
Spill Prevention Control and Countermeasure Plan	Goldstrike Mine	NA	Updated Every 5 years (Last Updated March 2007)
EIS/ROD – Betze Project	Betze Expansion of Goldstrike	BLM	06-14-91
SEIS/ROD – Betze Project	Dewatering Operations	BLM	04-01-03
POO Authorization/EA/FONSI (#N16-98-002P)	Goldstrike Exploration Project Area	BLM	09-24-99
Reclamation Permit (#0026)	Goldstrike Mine	BLM and BMRR/NDEP	4-16-07 through Mine Closure (Previous Permits Issued 5/91, 4/94, and 1/03)
Mining Bioremediation Facility (General Permit #GNV041995)	Bioremediation Facility	BMRR/NDEP	09-29-95 through Mine Closure
Bioremediation Permit (Individual #GNV041995IHP11)	Facility Roaster	BMRR/NDEP	04-01-99 through Mine Closure
Reclamation Permit (#0030)	Meikle Mine	BMRR/NDEP	12-23-99 through Mine Closure (Amendment to Original Permit Dated 10-92 and 01-93)
Reclamation Permit (#0179)	Goldstrike Exploration	BMRR/NDEP	04-12-99 through Mine Closure
Water Pollution Control Permit (#NEV89068)	Boulder Valley Infiltration Project	BMRR/NDEP	04-09-04 to 04-09-09
Water Pollution Control Permit (#NEV95114)	Boulder Valley Recirculation Project	BMRR/NDEP	Through 2012
Class III Landfill Waiver	Landfill	NDEP	Through Landfill Closure
Injection Well Permit (#NEV 93209)	11 Injection Wells in Boulder Valley	NDEP	11-99 to 11-04 Renewal Submitted, 1-02 acknowledged renewal status
Temporary Authorization to Discharge (#TNEV2008309)	Rodeo Creek Diversion Tributary to Rodeo and Boulder Creeks	NDEP	07-24-07 to 01-24-08
Storm Water Discharges General Permit (# NVR 300000)	Goldstrike Mine	NDEP	06-01-07 to 06-01-12
Water Pollution Control Permit (#NEV0090060)	AA Block/Brush Creek Water Quality Monitoring Locations, Mill 4, Tailings Storage Facilities 1 and 2	NDEP	01-03-07 to 08-18-10

Table A-1 Current Goldstrike Mine Permits and Authorizations

Permit Title	Portion of Operation Covered by Permit	Agency	Period Covered
Water Pollution Control Permit (#NEV91029)	North Block Project	NDEP	10-27-04 to 10-30-09 8-18-07 to 8-17-12
NPDES Permit (#NV0022675)	Boulder Valley Facility	NDEP	08/18/07 to 08/17/2012
Groundwater Discharge Permit and Temporary Authorization to Discharge (#NEV94002)	AA Block, Meikle Mine, and AA Tailings Facility	NDEP	05/07/08 to 05/07/2013
Open Burn Variance	Operation Area	NDEP	As needed
NPDES General Stormwater Permit (#NVR300000)	Operation Area	NDEP	06-01-07 to 06-01-12
Permit to Operate a Public Water System (#EU-5077-12NTNC)	Operation Area	NDEP	08-14-07 to 08-31-08 Renewal submitted
Arsenic Removal Treatment (#EU-5077-TP02-12-NTNC)	Operation Area	NDEP	01-02-28 to 08-28-08 Renewal submitted
Class I Air Quality Permit (Title V) (#AP1041-0739.02)	Entire Facility – Facility ID A0005	NDEP	July 2007 to July 2012
Phase I Mercury OPTC for System 18, Roasters 1 & 2	Process Area	NDEP-BAPC	08-01-06 to 06-16-11
Phase I Mercury OPTC for System 61, Carbon Reactivation Kiln	Process Area	NDEP-BAPC	08-01-06 to 06-16-11
Phase I Mercury OPTC for System 66, AC #1	Process Area	NDEP-BAPC	08-01-06 to 06-16-11
Phase I Mercury OPTC for System 66, AC #2/#3	Process Area	NDEP-BAPC	08-01-06 to 06-16-11
Phase I Mercury OPTC for System 66, AC #4	Process Area	NDEP-BAPC	08-01-06 to 06-16-11
Phase I Mercury OPTC for System 66, AC #5/#6	Process Area	NDEP-BAPC	08-01-06 to 06-16-11
Phase I Mercury OPTC for System 67, Retorts #1, #2, #3	Process Area	NDEP-BAPC	08-01-06 to 06-16-11
Phase I Mercury OPTC for System, 68, East & West Melting Furnaces and Electrowinning Cells	Process Area	NDEP-BAPC	08-01-06 to 06-16-11
Phase I Mercury OPTC for System 15 & 16	Process Area	NDEP-BAPC	08-01-06 to 06-16-11
Phase I Mercury OPTC for System 70, Analytical Laboratory	Process Area	NDEP-BAPC	08-01-06 to 06-16-11

Table A-1 Current Goldstrike Mine Permits and Authorizations

Permit Title	Portion of Operation Covered by Permit	Agency	Period Covered
February 4, 2008 ten Phase II permit applications for Mercury thermal sources (the sources listed above) were submitted to NDEP BAPC	Process Areas	NDEP-BAPC	Not applicable until approval, anticipated approval 06-16-2011
ROW Occupancy Permit (#EO-47-1999)	Street Sign 7.5 Miles from Mine	NDOT	09-30-99
NDOW Industrial Artificial Pond Permit (#S-26590, Formerly #S-19378)	AA Tailings Facility, Mill Facility	NDOW	04-01-05 to 03-31-10
Dam Construction or Alteration Application (#J-262)	AA Emergency Overflow	NDWR	02-17-87 (Valid for Life of Dam)
Dam Construction or Alteration Application (#J-278)	Goldstrike Tailings Dam	NDWR	02-10-88 (Valid for Life of Dam)
Dam Construction or Alteration Application (#J-309)	Mill 4-1 Tailings Dam	NDWR	02-23-89 (Valid for Life of Dam)
Dam Construction or Alteration Application (#J-320/460)	TS Ranch Dam	NDWR	07-12-96 (Valid for Life of Dam)
Dam Construction or Alteration Application (#J-332)	Rodeo Creek Diversion	NDWR	03-15-90 (Valid for Life of Dam)
Dam Construction or Alteration Application (#J-377, Modified from #J-507)	North Block Emergency Containment Pond	NDWR	03-11-99 (Valid for Life of Dam)
Dam Construction or Alteration Application (#J-489, Formerly #J-448 and #J-394)	North Block Tailings Dam	NDWR	09-21-98 (Valid for Life of Dam)
Dam Construction or Alteration Application (#J-400)	TS Ranch Delivery Pipeline Settlement Pond	NDWR	05-11-93 (Valid for Life of Dam)
Dam Construction or Alteration Application (#J-450)	Boulder Valley North Embankment	NDWR	12-13-95 (Valid for Life of Dam)
Dam Construction or Alteration Application (#J-451)	Boulder Valley Center Embankment	NDWR	12-13-95 (Valid for Life of Dam)
Dam Construction or Alteration Application (#J-452)	Boulder Valley South Embankment	NDWR	12-13-95 (Valid for Life of Dam)
Dam Construction or Alteration Application (#J-466)	TS Ranch Dam – Outlet Piping Alteration	NDWR	11-25-96 (Valid for Life of Dam)
Dam Construction or Alteration Application (#J-506)	Willow Creek Dam – Reconstruction and Alteration	NDWR	03-25-99 (Valid for Life of Dam)
Hazardous Materials	Operations Area	NV State Fire Marshal	03/01/08 to 02/28/09

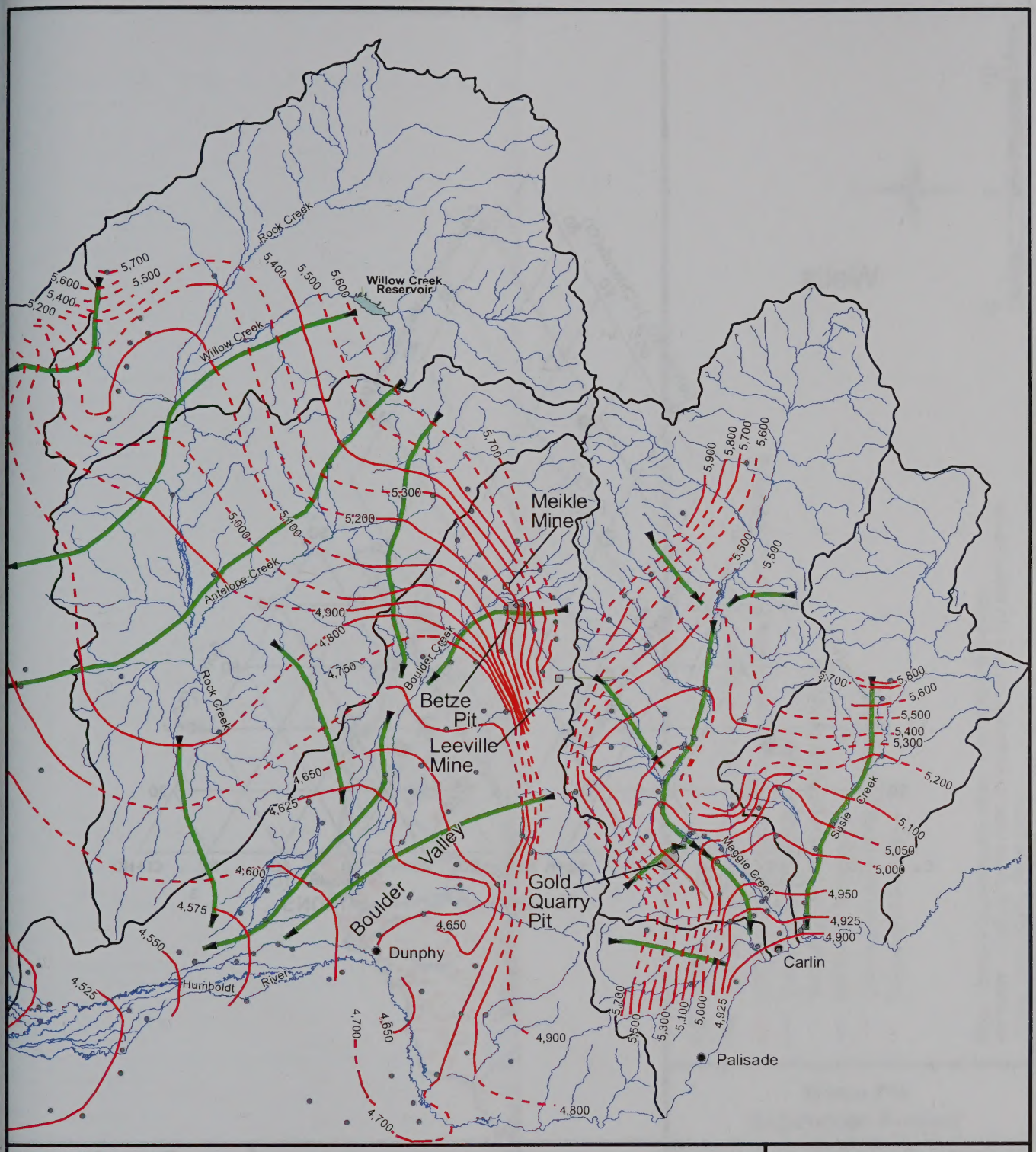
Table A-1 Current Goldstrike Mine Permits and Authorizations

Permit Title	Portion of Operation Covered by Permit	Agency	Period Covered
Jurisdictional Determination	Boulder, Bell, Brush and Rodeo Creeks	USACE	11-20-06 to 11-20-11
Hazardous Materials Certification of Registration	Operations Area	USDOT	06/30/08 to 06/30/2011

Source: BGMI 2007a.

GROUNDWATER RESOURCES AND GEOCHEMISTRY

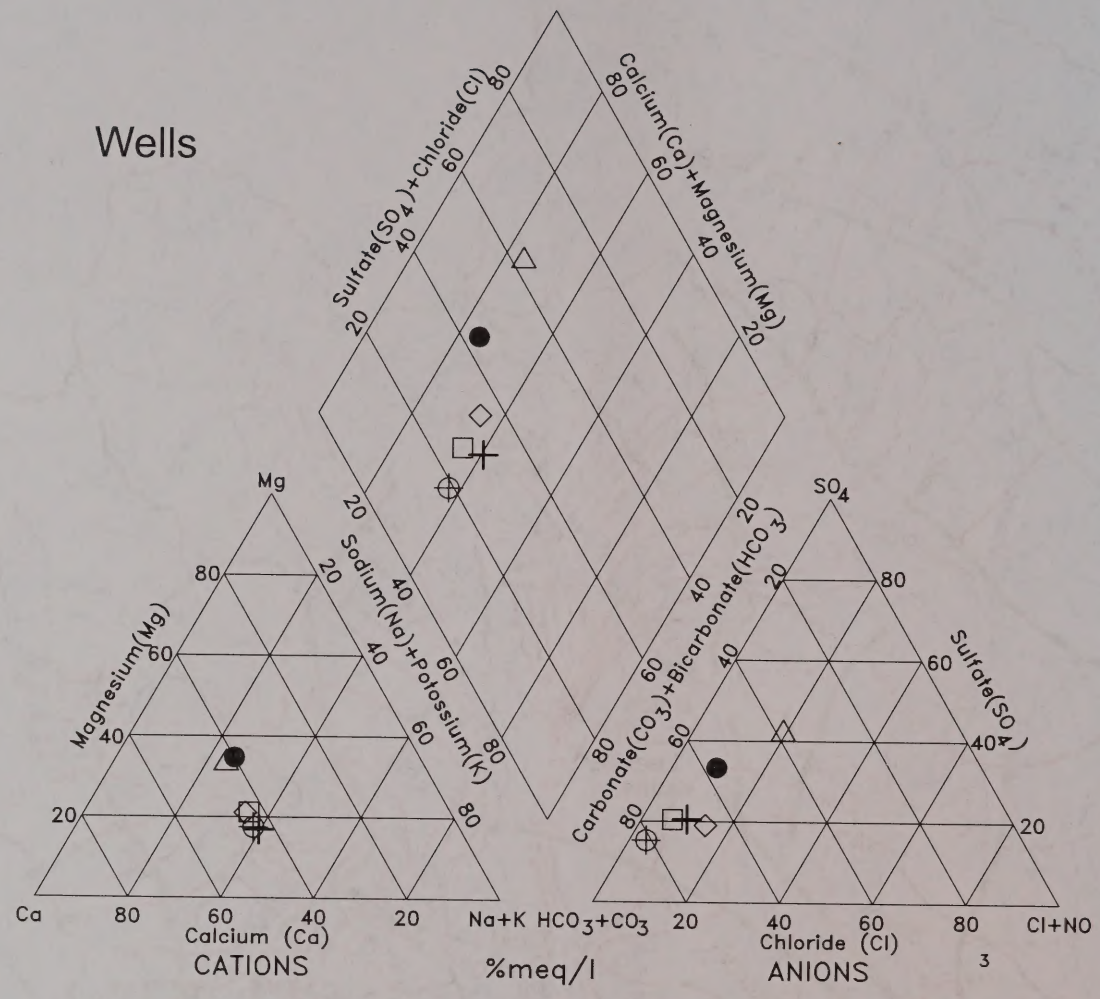
APPENDIX B



Betze Pit Expansion Project

Figure B-1

Pre-mining Groundwater Levels, 1990-1991



Legend

- ◇ Alluvium - Average
- □ Carlin Formation - Average
- △ Intrusive - Average
- + Volcanic - Average
- ⊕ Carbonate - Average
- ● Clastic - Average

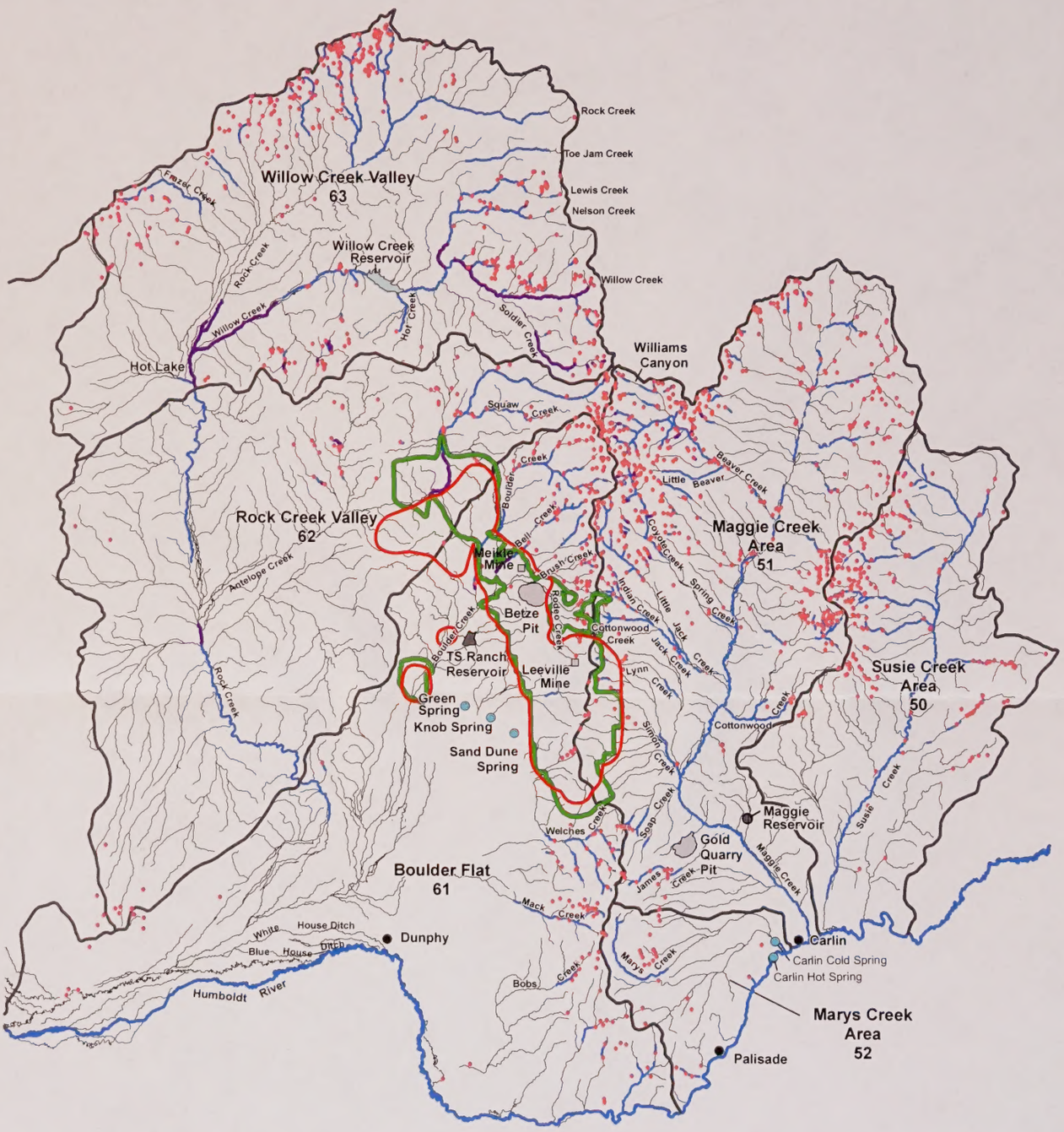
Source: BLM 2000a.

Betze Pit Expansion Project

Figure B-2

Piper Trilinear Diagram of Baseline Groundwater Chemistry

04/23/08



B-3

Figure B-3 Predicted Drawdown at Recovery Comparison 2000 to 2007 (Permanent Cone of Depression)	Betze Pit Expansion Project	LEGEND 10-Foot Drawdown Contour Expanded Pit (2007) 10-Foot Drawdown Contour, Current Mine Plan (BLM 2000a) Groundwater Basin Boundary Stream (Intermittent or Ephemeral) Perennial Stream Discontinous Flowing Stream Reach Seeps and Springs Note: Stream locations are taken from USGS line graph database. Hydrographic Area Boundary locations are approximate. Source: BLM 2000a; BGMI 2007a. N 0 5 10 Miles

07/24/2008



Table B-1 Water Quality Criteria and Standards for Nevada

Parameter[1] (mg/L)	Drinking Water Standards		Municipal or Domestic Supply	Aquatic Life[2]		Agriculture		
	Primary	Secondary		1-Hour Average	96-Hour Average	Irrigation	Stock Water	Wildlife Propagation
Antimony	0.006	--	0.146	--	--	--	--	--
Arsenic	0.05	--	0.05	0.34 As(III)	0.18 As(III)	0.1	0.2	--
Barium	2.0	--	2.0	--	--	--	--	--
Beryllium	0.004	--	0	--	--	0.1	--	--
Boron	--	--	--	--	--	0.75	5.0	--
Cadmium[3]	0.005	--	0.005	0.0062[4]	0.0015[4]	0.01	0.05	--
Chromium	0.1	--	0.10	0.015 Cr(VI)	0.01 Cr(VI)	0.1	1.0	--
Copper[3]	1.3	--	--	0.0253[4]	0.0161[4]	0.2	0.5	--
Iron	--	0.3 [0.6][5]	--	1.0	1.0	5.0	--	--
Lead[3]	0.05	--	0.05	0.0022[4]	0.0016[4]	5.0	0.1	--
Magnesium	--		125/150	--	--			
Manganese	--	0.05[0.1]	--	--	--	0.2	--	--
Mercury	0.002	--	0.002	0.002	0.000012	--	0.01	--
Molybdenum	--	--	--	0.019	0.019			
Nickel[3]	0.1	--	0.0134	1.919[4]	0.213[4]	0.2	--	--
Selenium	0.05	--	0.05	0.020	0.005	0.002	0.05	--
Silver	0.05	--	--	0.0089[4]	0.0089[4]	--	--	--
Thallium	0.002	--	0.013	--	--	--	--	--
Zinc[3]	--	5.0	--	0.159[4]	0.144[4]	2.0	25.0	--
Cyanide (WAD)	--	--	0.2	0.022	0.0052	--	--	--
Alkalinity	--	--	--	Less than 25% change		--	--	30-130
Chloride	--	250[400][5]	250[400]	--	--	--	1,500	1,500
Color (PCU)	--	15	75	--	--	--	--	--
Dissolved Oxygen	--	--	Aerobic	5.0	5.0	--	Aerobic	Aerobic
Fluoride	4.0	2.0	--	--	--	1.0	2.0	--
Nitrate as N	10	--	10	90(w)[6]	90(w)	--	100	100
pH (SU)	--	6.5-8.5	5.0-9.0	6.5-9.0	6.5-9.0	4.5-9.0	5.0-9.0	7.0-9.2
Sulfate	--	250[500]	250[500]	--	--	--	--	--
Temperature °C	--	--	--	Site-specific determination		--	--	--
TDS	--	500[1,000]	500[1,000]	--	--	--	3,000-7,000	--

Table B-1 Water Quality Criteria and Standards for Nevada

Parameter[1] (mg/L)	Drinking Water Standards		Municipal or Domestic Supply	Aquatic Life[2]		Agriculture		
	Primary	Secondary		1-Hour Average	96-Hour Average	Irrigation	Stock Water	Wildlife Propagation
TSS	–	–	–	25-80	25-80	–	–	–
Turbidity (NTU)	–	–	–	50(w);10(c)	50(w); 10(c)	–	–	–

[1] mg/L = milligrams per liter; PCU = photoelectric color units; SU = standard units; NTU = nephelometric turbidity units; TDS = total dissolved solids; TSS = total suspended solids; °C = degrees Celsius.

[2] Aquatic life standards are presented in mg/L rather than g/L.

[3] Dissolved fraction only.

[4] Parameter dependent on hardness; a hardness value of 175 mg/L was used to calculate the criteria for hardness-dependent metals.

[5] Numbers in brackets [ ] are mandatory secondary standards for public water systems.

[6] (w) refers to warm water and (c) is for cold water. No letter designation indicates criteria are common to both warm and cold water.

Source: NAC 445.119; NAC 445A.144.

Table B-2 Summary of Groundwater Chemistry by Hydrostratigraphic Unit

Constituent	Units	Alluvium				Volcanic				Carlin Formation			
		Number of Wells	Minimum	Maximum	Average	Number of Wells	Minimum	Maximum	Average	Number of Wells	Minimum	Maximum	Average
Physical and Aggregate Properties													
TDS	mg/L	10	160	750	323	20	170	760	375	16	180	630	478
Inorganic Nonmetallic Constituents													
Chloride	mg/L	10	6.7	82	23	20	11.0	64	21	16	4.0	41.0	16.6
Fluoride	mg/L	10	0.24	2.8	0.64	20		3	1.4	16	0.29	1.60	1.14
pH	SU	10	7.0	8.9	7.6	20	3.5	9.3	7.7	16	6.3	9.8	7.4
Sulfate	mg/L	10	20	82	45	20	11.0	180	58	16	29.0	130.0	73.2
Temperature	°C	10	9.0	61.3	12.4	20	12.0	63	24	16	11.0	55.0	38.9
Alkalinity	mg/L	10	67	203	153	20	2. 5	440	228	16	100	440	273
Bicarbonate	mg/L	10	82	248	186	20	3.0	536	277	16	122	536	333
Sodium	mg/L	10	17	57	34	20	18.0	92.6	50.9	16	16.0	85.0	58.2
Potassium	mg/L	10	3.3	28	7.3	20	2.4	21	10	16	4.40	35.00	16.61
Calcium	mg/L	10	15.0	75	42	20	15.0	88	53	16	26.0	100.0	74.1
Dissolved Metals/Semi-metals													
Antimony	mg/L	10	0.0025	0.025	0.006	20	0.0020	0.025	0.008	16	<0.019	<0.019	*
Arsenic, Total	mg/L	10	0.002	0.170	0.023	20	0.003	0.21	0.022	16	0.005	0.410	0.027
Boron	mg/L	10	0.05	0.60	0.12	20	0.05	0.84	0.31	16	0.091	1.080	0.685
Iron	mg/L	10	0.005	100	2.8	20	--	59	1.7	16	0.010	220	1.558
Lead	mg/L	10	0.025	0.025	0.02	20	0.025	0.025	0.025	16	0.001	0.310	0.018
Magnesium	mg/L	10	3.7	35	12	20	5.8	30	13	16	10.0	48.0	21.0
Manganese	mg/L	10	0.001	2.8	0.1	20	--	2.9	0.1	16	0.005	2.000	0.036
Mercury	mg/L	10	0.0001	0.0002	0.0001	20	0.00005	0.00015	0.00007	16	0.00010	0.00500	0.00052
Selenium	mg/L	10	0.0025	0.05	0.01	20	0.0025	0.05	0.01	16	0.001	0.007	0.004
Thallium	mg/L	10	0.001	0.0025	0.001	20	0.0025	0.025	0.01	16	0.011	0.210	0.107
Zinc	mg/L	10	0.0025	0.042	0.01	20	0.0025	0.071	0.02	16	0.003	2.200	0.031

Table B-2 Summary of Groundwater Chemistry by Hydrostratigraphic Unit

Constituent	Units	Intrusive				Marine Clastic				Marine Carbonate			
		Number of Wells	Minimum	Maximum	Average	Number of Wells	Minimum	Maximum	Average	Number of Wells	Minimum	Maximum	Average
Physical and Aggregate Properties													
TDS	mg/L	7	270	510	392	13	185	450	305	24	310	672	566.2
Inorganic Nonmetallic Constituents													
Chloride	mg/L	7	4.0	81.0	46.3	13	3.4	69.0	17.0	24	3.0	19	14.9
Fluoride	mg/L	7	0.21	0.90	0.47	13	0.36	0.70	0.50	24	0.6	1.6	1.3
pH	SU	7	6.3	8.9	8.0	13	6.4	9.2	7.6	24	5.1	8	6.7
Sulfate	mg/L	7	45.0	190.0	134.1	13	43.0	190.0	80.4	24	48.0	160	77.0
Temperature	°C	7	11.0	35.0	21.1	13	11.0	40.0	23.5	24	29.0	60	51.3
Alkalinity	Mg/L	7	75	170	127	13	100.0	180	140	24	160.0	480	422.0
Bicarbonate	Mg/L	7	91	207	155	13	122	219	171	24	195.1	585.216	514.5
Sodium	Mg/L	7	20.0	44.0	30.7	13	15.8	36.0	23.6	24	21.0	85.5	73.9
Potassium	Mg/L	7	2.60	8.10	5.51	13	4.40	8.90	6.35	24	6.6	25	20.9
Calcium	Mg/L	7	32.0	80.0	51.8	13	28.0	57.0	38.7	24	39.0	109	88.9
Dissolved Metals/Semi-metals													
Antimony	Mg/L	7	0.039	0.039	0.039	13	<0.019	<0.019	*	24	0.022	0.050	0.035
Arsenic, Total	Mg/L	7	0.020	0.200	0.095	13	0.002	0.570	0.113	24	0.008	0.451	0.021
Boron	Mg/L	7	0.084	0.100	0.094	13	0.047	0.107	0.094	24	0.600	0.847	0.767
Iron	Mg/L	7	0.020	4.300	0.463	13	0.020	3.400	0.468	24	0.030	14.7	0.308
Lead	Mg/L	7	0.001	0.012	0.007	13	0.001	0.007	0.004	24	<0.001	0.012	0.007
Magnesium	Mg/L	7	12.0	38.0	25.5	13	11.0	37.2	20.3	24	19.0	32.0	21.9
Manganese	Mg/L	7	0.002	1.200	0.114	13	0.005	0.342	0.083	24	0.007	0.092	0.013
Mercury	Mg/L	7	0.0001	0.0001	0.000	13	0.00010	0.00028	0.00019	24	0.0001	0.00222	0.0007
Selenium	Mg/L	7	0.006	0.013	0.010	13	0.001	0.001	0.001	24	0.002	0.004	0.004
Thallium	Mg/L	7	0.002	0.002	0.002	13	<0.001	<0.001	*	24	<0.001	<0.001	*
Zinc	Mg/L	7	0.005	0.069	0.017	13	0.005	0.100	0.026	24	0.002	0.180	0.017

*Average below detection limit.

Note: Constituents which exceed Nevada Drinking Water Primary Standards are shown in bold.

Source: BLM 2000a.

Table B-3 Boulder Valley Monitoring Data – First Quarter 2007 – Selected Monitoring Wells and Springs

		Boulder Valley Monitoring Wells[2]													Boulder Valley Springs		
Parameters[1]	Units	NA-01A	NA-10	NA-18	NA-22	NA-26	NA-29	NA-32	NA-34	IMW-93-1	IMW-93-2	IMW-93-3	IMW-93-4	IMW-95-1	Sand Dune Spring	Knob Spring	Green Spring
Alkalinity	mg/L	169	254	290	280	109	90.7	141	110	111	119	102	216	207	241	242	262
Aluminum	mg/L	<0.08	<0.08	<0.08	<0.03	<0.08	<0.03	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Antimony	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Arsenic	mg/L	<0.025	0.0377	0.0329	0.04	0.0078	<0.025	0.0066	0.0109	<0.025	<0.025	0.0034	0.0085	0.0106	0.0115	0.0111	0.0119
Barium	mg/L	0.064	0.0561	0.0599	0.069	0.0737	0.025	0.0819	0.0843	0.0221	0.0713	0.0751	0.0714	0.0622	0.0854	0.0791	0.104
Beryllium	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Bicarbonate	mg/L	169	254	290	280	109	90.7	141	110	87.8	119	102	216	195	241	235	253
Boron	mg/L	0.08	0.53	0.47	0.54	0.11	0.11	0.12	0.1	0.2	0.12	0.25	0.31	0.21	0.25	0.24	0.29
Cadmium	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Calcium	mg/L	36.7	56	76.1	63.1	22.8	27.6	33.9	29.7	3.21	36.5	18	56.9	41.5	57	56.5	58.4
Carbonate	mg/L	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	23	<1.0	<1.0	<1.0	12.2	<1.0	6.7	9.4
Chloride	mg/L	28.7	21.7	20	34.2	10.3	28.6	10.9	9.65	40.6	22.8	36.8	18.6	15.4	15.4	14.6	17.6
Chromium	mg/L	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006	<0.006
Copper	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.012	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Conductivity	µmho/cm	463	704	721	833	286	391	361	302	346	366	404	584	453	607	487	641
Fluoride	mg/L	0.83	1.14	1.13	2.15	0.99	2.16	0.56	0.54	2.03	0.56	1.38	1.38	2.08	2.35	2.94	2.59
Iron	mg/L	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06	0.15	<0.06	0.08	<0.06	<0.06	<0.06
Lead	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Magnesium	mg/L	9.25	15.5	17.9	14.6	4.83	5.04	8.88	6.15	2.95	6.54	7.68	12.9	9.03	15.9	13	15
Manganese	mg/L	<0.004	<0.004	<0.004	<0.004	<0.004	0.009	<0.004	<0.004	<0.004	<0.004	0.013	<0.004	0.017	<0.004	0.01	0.008
Mercury	mg/L	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Table B-3 Boulder Valley Monitoring Data – First Quarter 2007 – Selected Monitoring Wells and Springs

		Boulder Valley Monitoring Wells[2]													Boulder Valley Springs		
Parameters[1]	Units	NA-01A	NA-10	NA-18	NA-22	NA-26	NA-29	NA-32	NA-34	IMW-93-1	IMW-93-2	IMW-93-3	IMW-93-4	IMW-95-1	Sand Dune Spring	Knob Spring	Green Spring
Nickel	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nitrite-Nitrate	mg/L	**1.47**	0.765	0.897	0.66	0.82	**4.06**	**1.05**	0.789	<0.02	**2.73**	<0.02	**1.06**	0.042	<0.03	0.371	0.466
pH	SU	7.57	7.52	7.47	7.61	7.67	7.95	7.31	7.45	**9.13**	7.62	8.27	7.32	8.5	8.04	8.34	8.38
Potassium	mg/L	4.39	13.3	9.86	8.63	4.69	4.09	5.97	5.6	8.37	5.1	8.12	9.66	9.26	9.93	9.91	11.4
Selenium	mg/L	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Silver	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Sodium	mg/L	52.2	68.2	55.7	91.6	25.1	38.9	23.1	17.9	59.2	28.9	51.1	37.8	39.7	35.4	36.5	42.9
Sulfate	mg/L	31.9	88.1	68.2	94.2	27.9	35.4	29.8	26.7	<0.3	27.7	50.5	57.5	16.6	47.5	43.3	50.6
Temperature	°C	10.6	14.3	15.6	15	14.6	25.3	12.3	12.8	15.6	14.8	13.8	14.7	14.5	24.2	18.9	16.7
Thallium	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
TDS	mg/L	289	431	440	571	187	230	249	211	159	238	229	372	281	357	350	286
Water Level	feet bgs	181.7	399.7	387.31	197.59	82.29	875.56	31.56	17.03	313.06	210.17	55.3	57.37	62.71			
Zinc	mg/L	<0.01	0.027	<0.01	<0.01	<0.01	0.101	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

[1]All metals reported as dissolved.

[2]Groundwater wells shown on **Figure 3.3-2.**

Note: Constituents which exceed Nevada Drinking Water Primary Standards are shown in bold.

µmho = micromoho

bgs = below ground surface

Source: Data from Feb/March 2007 (BGMI 2007f).

Table B-4 Summary of Betze Seeps and Springs Sampling Sites

Catchment	Waterbody Type	Sampling Site	Date Sampled/ Visited	Elevation (feet)	Location (Latitude & Longitude)		2006 Survey Notes
Upper Rodeo Creek Catchment	Springs	117	9/27/06	6,000	40°58.267'	116°19.533'	Trickle flow, not measurable; vegetation comparable to previous years.
		121	9/27/2006	6,200	40°57.443'	116°19.127'	Very low flow; vegetation comparable to previous years. Evidence of use of this site by elk.
		126	9/27/2006	6,206	40°57.019'	116°19.276'	Highest flow recorded during monitoring period, the sampling location was moved from its original site to about 100 years downstream (as during 1999 sampling); vegetation comparable to previous years. Evidence of elk utilization at this site, but less than at Site 121.
Brush Creek Catchment	Creek	BC	NA	5,400	40°59.383'	116°21.933'	Site dramatically disturbed by mining activities in 2004. Site removed from monitoring program in 2006.
		93	9/27/2006	5,917	40°59.400'	116°19.617'	Limited trickle flow, flyover; vegetation comparable to previous years.
	Springs	98	9/27/2006	6,200	40°59.142'	116°18.998'	Very low flow; vegetation comparable to previous years.
		100	9/27/2006	6,199	40°59.328'	116°18.825'	Very low flow; vegetation comparable to previous years.

Table B-4 Summary of Betze Seeps and Springs Sampling Sites

Catchment	Waterbody Type	Sampling Site	Date Sampled/ Visited	Elevation (feet)	Location (Latitude & Longitude)		2006 Survey Notes
Bell Creek Catchment	Springs	70B	9/26/2006	5,795	41°02.065'	116°21.700'	Low flow; Site lightly grazed; vegetation comparable to other years.
		74	9/26/2006	6,768	41°02.550'	116°19.045'	Low flow; Site moderately grazed; vegetation cover somewhat lower than previous years, when the site was not grazed.
Boulder Creek Catchment	Springs	55	9/26/2006	6,861	41°03.782'	116°19.025'	Low flow; site heavily grazed; vegetation cover comparable to previous years when the site was grazed. Stream bank undercutting may result in slope failure near the transect starting point.
		19	9/26/2006	7,000	41°06.431'	116°18.477'	Trickle flow but highest on record, with most flow below armoring rocks; Site heavily grazed; vegetation cover lower than previous years.
		A2	9/26/2006	7,423	41°06.333'	116°19.833'	Limited flow, flyover only; vegetation as site comparable to previous years.
		24	9/26/2006	7,196	41°05.891'	116°18.789'	Low flow but highest on record; site grazed – vegetation cover values comparable to other years when the site has been grazed.
		6	9/26/2006	5,400	41°00.040'	116°25.487'	Dry, vegetation comparable to the past 6 years. General trend of decreasing total vegetation cover; Site heavily grazed.
		88	9/26/2006	5,400	40°59.417'	116°25.667'	Dry, flyover only; site comparable to previous years.

Table B-4 Summary of Betze Seeps and Springs Sampling Sites

Catchment	Waterbody Type	Sampling Site	Date Sampled/ Visited	Elevation (feet)	Location (Latitude & Longitude)		2006 Survey Notes
Indian Creek Catchment	Springs	111	9/27/2006	6,000	40°58.160'	116°16.360'	Moderate flow; not as much watercress as in previous years. Some bank undercutting upstream of water sampling site; site heavily grazed.
		104	9/27/2006	6,390	40°59.665'	116°17.301'	Low flow; limited grazing; vegetation comparable to previous years.
Beaver Creek Catchment	Springs	A1	9/26/2006	7,625	41°06.471'	116°17.853'	Trickle flow; vegetation at transect heavily grazed – comparable to earlier years when the site has been grazed.
Rock Creek Catchment	Creek	RKC-1	9/25/2006	4,955	41°02.954'	116°43.398'	Flow close to historic mean; vegetation lightly grazed; substantial growth of coyote willows. Evidence of high flows earlier in the growing season.
		RKC-2	9/25/2006	4,870	40°57.447'	116°42.721'	Flow close to historic mean; the sampling location was moved from its previous site about 150 yards downstream; site heavily grazed but comparable to previous years.
		RKC-3	9/25/2006	4,810	40°53.286'	116°41.339'	Flow close to historic mean; site lightly grazed but comparable to previous years; evidence of high flows earlier in the growing season; adjacent vegetation burned in 2006.
		RKC-4	9/25/2006	4,680	40°49.568'	116°35.196'	Flow close to historic mean; vegetation comparable to previous years.

Table B-4 Summary of Betze Seeps and Springs Sampling Sites

Catchment	Waterbody Type	Sampling Site	Date Sampled/ Visited	Elevation (feet)	Location (Latitude & Longitude)		2006 Survey Notes
Antelope Creek Catchment	Springs	S38-49-28A	9/26/2006	5,619	41°08.302'	116°27.249'	Very low flow but highest on record; significant algae growth; site only lightly grazed; more vegetation cover than in 2005.
		S38-49-34A	9/26/2006	5,600	41°07.150'	116°25.936'	Similar flow conditions compared with last year; vegetation comparable to previous years.
		S37-49-08L	9/25/2006	5,390	41°06.064'	116°27.911'	Highest flow on record. Water conditions comparable to 2005, but less vegetation cover. More grazing in 2006.
	Creek	ANT-1	9/25/2006	5,315	41°04.506'	116°27.404'	Highest flow on record; heavily grazed. Original transect site covered with sediment deposited in association with high stream flows in 2005. New transect location selected and sampled. 2006 conditions comparable to 2005.
		ANT-2	9/25/2006	5,065	41°02.234'	116°33.934'	Dry, flyover only; dry channel – only scattered plants.
		ANT-3	9/25/2006	4,925	40°59.945'	116°39.388'	Lowest flow on record – heavily grazed. Major species is water speed in the channel. Very little development of riparian vegetation.

Table B-4 Summary of Betze Seeps and Springs Sampling Sites

Catchment	Waterbody Type	Sampling Site	Date Sampled/ Visited	Elevation (feet)	Location (Latitude & Longitude)		2006 Survey Notes
Outlying Seeps and Springs in the northern extreme of the Sheep Creek Range	Springs	S37-48-19A	9/25/2006	5,438	41°04.264'	116°35.850'	Highest flow on record; vegetation cover much higher than any previous year. No grazing. God development of wetland vegetation. Upland areas burned in 2006.
		S37-48-21L	9/25/2006	5,698	41°05.338'	116°35.321'	Highest flow on record; Site heavily grazed and trampled by livestock. Upland areas burned in 2006; sampling directly from spring containment unit.
		S38-48-19A	9/25/2006	5,857	41°09.312'	116°35.059'	No measurable flow; site not grazed in 2006; more vegetation cover than in 2005.
		S38-48-11A	9/26/2006	5,509	41°10.975'	116°30.502'	Highest flow on record; vegetation cover higher than previous years; site not grazed. Water cress abundant in stream channel.
		S39-48-31A	9/26/2006	5,240	41°13.053'	116°36.124'	Similar flow conditions compared with past observations; vegetation cover comparable to previous years; site lightly grazed. Water cress abundant in stream channel.
		S39-48-31B	9/26/2006	5,287	41°13.069'	116°35.979'	Similar flow conditions compared with past observations; Site saturated and muddy in portions closest to seep; not grazed in 2006.
		S39-48-33A	9/26/2006	5,476	41°13.151'	116°33.006'	Similar flow conditions compared with past observations; not grazed in 2006; comparable species composition; grass and cobble bed.

Source: AATA 2007; JBR 1992a; RTi 1994.

Table B-5 Field Survey Form – Fall 2006 Betze Seep and Spring Study

Location Site	Upper Rodeo Creek Catchment		Brush Creek Catchment		Bell Creek Catchment	
	121	126	98	100	70B	74
Date	9/27/2006	9/27/2006	9/27/2006	9/27/2006	9/26/2006	9/26/2006
Water Temperature (°C)	7.8	10.6	8.1	11.3	16.7	17.5
Discharge (gpm)	0.26	2.37	0.66	0.10	7.50	4.87
Discharge (cfs)	0.0006	0.0053	0.0015	0.0002	0.0167	0.0108
TDS mg/L	244.5	262.3	477.5	441.7	252.6	148.6
Conductivity (µS)	345.7	372.7	670.9	621.5	365.8	216.9
pH	6.9	7.56	7.69	6.91	6.83	7.44

Location Site	Boulder Creek Catchment			Beaver Creek Catchment	Indian Creek Catchment	
	19	24	55	A1	104	111
Date	9/27/2006	9/27/2006	9/27/2006	9/27/2006	9/26/2006	9/26/2006
Water Temperature (°C)	17.5	16.0	12.7	18.0	9.7	13.5
Discharge (gpm)	0.44	2.20	7.55	0.56	3.24	83.88
Discharge (cfs)	0.0010	0.0049	0.0168	0.0013	0.0072	0.1872
TDS mg/L	60.44	96.70	195.7	44.96	256.9	233.9
Conductivity (µS)	89.5	143.4	283.1	67.34	367.6	336.1
pH	7.14	7.61	7.38	7.59	7.92	7.74

Location Site	Rock Creek Catchment			
	RKC-1	RKC-2	RKC-3	RKC-4
Date	9/25/2006	9/25/2006	9/25/2006	9/25/2006
Water Temperature (°C)	13.5	14.3	11.6	10.5
Discharge (gpm)	2321.57	2309.34	3787.34	3779.21
Discharge (cfs)	5.1725	5.1452	8.4383	8.4201
TDS mg/L	232.9	222.1	229.3	227.4
Conductivity (µS)	339.3	320.8	328.9	325.4
pH	8.30	8.51	8.42	7.73

Table B-5 Field Survey Form – Fall 2006 Betze Seep and Spring Study

Location Site	Antelope Creek Catchment				
	S38-49-28A	S38-49-34A	S37-49-08L	ANT-1B	ANT-3
Date	9/26/2006	9/26/2006	9/25/2006	9/25/2006	9/25/2006
Water Temperature (°C)	15.8	18.2	20.4	18.8	20.9
Discharge (gpm)	0.99	6.91	271.77	281.93	2.82
Discharge (cfs)	0.0022	0.0154	0.6065	0.6292	0.0063
TDS mg/L	197.4	299.7	404.6	414.5	306.1
Conductivity (µS)	287.5	430.6	583.5	592.6	444.9
pH	7.48	7.27	8.13	8.40	8.09

Location Site	North Extreme of the Sheep Creek Range					
	S37-48-19A	S37-48-21L	S38-48-11A	S39-48-31A	S39-48-31B	S39-48-33A
Date	9/25/2006	9/25/2006	9/26/2006	9/26/2006	9/26/2006	9/26/2006
Water Temperature (°C)	16.3	17.3	18.7	6.5	13.1	15.5
Discharge (gpm)	20.47	11.08	214.73	5.06	32.49	30.80
Discharge (cfs)	0.0456	0.0247	0.4792	0.0113	0.0722	0.0685
TDS mg/L	420.2	300.1	123.4	183	171.6	126.4
Conductivity (µS)	615	433.7	182.1	260.7	249.5	184.9
pH	7.40	7.35	7.71	6.78	7.34	7.83

Source: AATA 2007.

Table B-6 Chemical Analysis Results of the Betze Seeps and Springs Survey (2006)

Site	TDS mg/L	Conductivity µmho/cm	pH SU	As[1] mg/L	B[1] mg/L	Fe[1] mg/L	Mn[1] mg/L	Total P mg/L	CO_3 mg/L	HCO_3 mg/L	Cl mg/L	F mg/L	SO_4 mg/L	Ca mg/L	K mg/L	Mg mg/L	Na mg/L	TSS mg/L	Alkalinity mg/L
A1	44.96	67.3	7.6	<0.003	<0.04	0.23	0.008	0.02	<1.0	16.6	0.6	<0.10	2.44	2.96	2.31	0.94	3.57	<5	16.6
19	60.44	89.5	7.1	<0.003	0.05	0.30	0.023	0.13	<1.0	37.5	1.9	<0.10	4.91	7.85	2.77	2.50	6.44	28	37.5
24	96.70	143.4	7.6	<0.003	<0.04	0.21	0.008	0.20	<1.0	62.0	2.5	0.15	8.93	15.10	2.62	5.90	5.91	15	62.0
55	195.70	283.1	7.4	<0.003	<0.04	0.11	0.106	0.10	<1.0	64.1	3.0	0.20	71.40	30.10	2.41	13.00	7.23	<5	64.1
70B	252.60	365.8	6.8	<0.003	0.08	0.17	0.443	0.26	<1.0	127.0	7.4	0.29	58.509	38.60	8.03	15.10	14.30	5	127.0
74	148.60	216.9	7.4	<0.003	<0.04	0.08	0.011	0.53	<1.0	74.7	2.3	0.15	32.80	23.10	2.25	8.78	6.92	73	74.7
98	477.50	670.9	7.7	<0.003	<0.04	<0.06	**0.534**	0.23	<1.0	235.0	5.1	0.44	138.00	80.80	2.58	38.60	15.50	12	235.0
100	441.70	621.5	6.9	0.0038	0.05	<0.06	<0.004	0.37	<1.0	170.0	9.6	0.31	154.00	71.30	4.13	31.40	22.00	<5	170.0
104	256.90	367.6	7.9	<0.003	<0.04	<0.06	<0.004	0.17	<1.0	142.0	2.6	0.18	54.80	40.60	2.38	21.00	7.63	16	142.0
111	233.90	336.1	7.7	<0.003	<0.04	<0.06	0.006	0.18	<1.0	129.0	3.3	0.38	47.30	36.50	2.28	19.80	6.74	<5	129.0
121	244.50	345.7	6.9	0.0042	0.05	<0.06	0.034	0.07	<1.0	25.7	7.3	0.31	128.00	29.00	5.28	16.20	10.80	<5	25.7
126	262.30	372.7	7.6	**0.0781**	0.08	<0.06	0.028	0.14	<1.0	117.0	8.0	0.57	67.00	39.90	5.51	14.10	16.50	23	117.0
RKC-1	232.90	339.3	8.3	0.0067	0.08	0.17	0.024	0.15	2.1	121.0	18.4	0.29	29.30	28.70	6.22	7.31	30.90	13	123.0
RKC-2	222.10	320.8	8.5	0.0076	0.09	0.296	0.038	0.23	<1.0	126.0	16.9	0.27	27.10	28.00	6.70	7.34	34.40	79	126.0
RKC-3	229.30	328.9	8.4	0.0083	0.09	0.17	0.025	0.18	5.0	120.0	17.6	0.30	26.10	29.70	6.41	7.26	30.50	9	125.0
RKC-4	227.40	325.4	7.7	0.0080	0.09	<0.17	0.017	0.19	<1.0	121.0	17.7	0.39	26.50	29.50	5.98	7.32	28.60	15	121.0
S37-48-21L	300.10	433.7	7.4	0.0432	0.11	<0.06	<0.004	0.02	<1.0	150.0	21.5	0.62	29.70	41.10	3.15	8.52	38.90	<5	150.0
S37-48-19A	420.2	615.0	7.4	0.0122	0.13	<0.06	0.006	0.02	<1.0	19.0	45.7	0.50	50.60	73.30	4.50	11.00	41.90	<5	199.0
S37-49-08L	404.60	583.5	8.1	0.053	0.13	<0.06	0.033	0.020	4.7	176.0	36.3	0.56	76.40	46.50	9.61	16.40	50.80	17	181.0
S38-48-11A	124.40	182.1	7.7	<0.003	0.06	<0.06	<0.003	0.05	<1.0	53.5	11.0	0.47	14.30	14.50	3.,20	2.95	18.30	6	53.5
S38-49-28A	197.40	287.5	7.5	<0.003	0.05	<0.06	<0.004	0.01	<1.0	101.0	10.0	0.39	32.10	24.60	5.50	7.78	23.70	<5	101.0
S38-49-34A	299.70	430.6	7.3	<0.003	0.08	<0.06	0.005	<0.010	<1.0	154.0	14.9	0.47	57.30	33.90	5.94	13.50	37.00	<5	154.0

Table B-6 Chemical Analysis Results of the Betze Seeps and Springs Survey (2006)

Site	TDS mg/L	Conductivity µmho/cm	pH SU	As[1] mg/L	B[1] mg/L	Fe[1] mg/L	Mn[1] mg/L	Total P mg/L	CO_3 mg/L	HCO_3 mg/L	Cl mg/L	F mg/L	SO_4 mg/L	Ca mg/L	K mg/L	Mg mg/L	Na mg/L	TSS mg/L	Alkalinity mg/L
S39-48-31A	183.00	260.7	6.8	<0.003	0.06	<0.06	<0.004	0.02	<1.0	62.9	21.3	0.95	24.50	20.10	3.25	4.01	25.50	<5	62.9
S39-48-31B	171.60	249.5	7.3	<0.003	0.07	0.06	0.006	0.03	<1.0	59.4	19.3	0.94	21.20	19.70	3.05	3.77	23.50	28	59.4
S39-48-33A	126.40	184.9	7.8	<0.003	0.07	<0.06	<0.004	0.01	<1.0	49.0	14.6	1.33	15.10	14.80	2.08	2.84	15.40	5	49.0
ANT-1B	414.50	592.6	8.4	0.0051	0.11	0.06	0.023	0.17	9.0	179.0	33.2	0.39	77.40	49.90	8.79	18.10	52.50	18	188.0
ANT-3	306.10	444.9	8.1	0.0125	0.11	<0.06	0.011	0.07	12.8	180.0	15.4	0.42	29.20	45.80	6.95	10.40	36.70	<5	193.0

[1]Concentrations of As, B, Fe, and Mn are dissolved.

Note: Constituents which exceed Nevada Drinking Water Primary Standards are shown in bold.

Source: AATA 2007.

Table B-7 Representative Water Chemistry Input Values for Simulating Rainfall, Carbonate Groundwater, Carlin Groundwater, and Rodeo Creek Water

Representative Water	Station	Sample Date	Temperature (°C)	Total Suspended Solids (mg/L)	pH (SU)	Electrical Conductivity (us/cm)	Total Dissolved Solids (mg/L)	Alkalinity mg/L	Calcium Dissolved (mg/L)	Magnesium Dissolved (mg/L)	Sodium Dissolved (mg/L)
Carbonate	BW-36	12/12/07	53.3		7.35	1370	585	402	92.4	23	74.5
Carlin	PPW-58	12/20/95	22		8.00		423	172.4	48.8	19.3	30.7
Rainfall	Site ID:NV01	1984 to 1998			5.14	6.05			0.175	0.029	0.125
Rodeo Creek	RC-A	04/22/93	10	42	8.39	850	621.5	140	120	37	62

Representative Water	Potassium Dissolved (mg/L)	Bicarbonate (mg/L)	Sulfate (mg/L)	Chloride (mg/L)	Boron Dissolved (mg/L)	Fluoride (mg/L)	Ammonium Ion (mg/L)	Nitrite-Nitrate (mg/L)	Phosphorus Total (mg/L)
Carbonate	21.2	402	73.3	14.8	0.75	1.36		<0.020	
Carlin	12.9	172.4	76.9	17.5	< 0.01	0.29	< 0.1	0.64	0.07
Rainfall	0.02		0.43	0.13			0.08	0.62	
Rodeo Creek	6.9	85.4	150	160	0.2	< 0.5	< 0.2	13	0.26

Source: Schafer 2007.

Table B-7 **Representative Water Chemistry Input Values for Simulating Rainfall, Carbonate Groundwater, Carlin Groundwater, and Rodeo Creek Water**

Representative Water	Aluminum Dissolved (mg/L)	Antimony Dissolved (mg/L)	Arsenic Dissolved (mg/L)	Barium Dissolved (mg/L)	Beryllium Dissolved (mg/L)	Cadmium Dissolved (mg/L)	Chromium Dissolved (mg/L)	Copper Dissolved (mg/L)	Iron Dissolved (mg/L)
Carbonate	<0.080	0.0037	0.076	0.157	<0.0020	<0.0020	<0.0060	<0.010	0.134
Carlin	< 0.02	< 0.01	0.01	0.05	< 0.001	< 0.0024	< 0.005	< 0.003	< 0.02
Rainfall			0.001						
Rodeo Creek	< 0.1		0.15	0.16		< 0.005	< 0.005	< 0.005	0.02

Representative Water	Lead Dissolved (mg/L)	Manganese Dissolved (mg/L)	Mercury Dissolved (mg/L)	Nickel Dissolved (mg/L)	Selenium Dissolved (mg/L)	Silicon Dissolved (mg/L)	Silver Dissolved (mg/L)	Thallium Dissolved (mg/L)	Zinc Dissolved (mg/L)
Carbonate	<0.0030	0.017	<0.00020	<0.010	<0.0030	18.5	<0.0050	<0.0020	<0.010
Carlin	< 0.001	< 0.001	< 0.0002	< 0.01	< 0.01	36.4	< 0.003	< 0.001	< 0.002
Rainfall									
Rodeo Creek	< 0.005	0.16	0.0004		< 0.005	18	< 0.005		0.08

Source: Schafer 2007

Summary of changes to the Barrick Goldstrike Hydrologic Model

Memo from J. Zhan, BGMI Senior Hydrologist in Support of Betze Pit Expansion SEIS

December 5, 2007

Since the 2003 Betze Project SEIS model, development and calibration of the Barrick Goldstrike Hydrologic Model have continued, as 1) simulation of new scenarios and generation of new results have revealed modifications to be made, and 2) additional data have become available to improve model calibration.

Modifications

The model has been modified to correct a few unrealistic results caused by dry cells. Some examples follow.

- One example was the alluvium/Carlin formation overlying the layer 2 carbonate and adjacent to the layer 1 carbonate. The drying of layer 1 of the Betze carbonate aquifer cut off some flow paths in the model, causing some water levels to rise as the carbonate water level continued to fall. As layer 1 was rewet during the recovery simulation, the same adjacent, fully recovered formations would then contribute unrealistic slugs of water to the pit. The situation was corrected by the addition of a horizontal flow barrier separating the alluvium/Carlin from the layer 1 carbonate. By preventing horizontal flow the model effectively represents the thinning of the alluvium/Carlin near the carbonate outcrop, improving the previous representation of the unit as a rectangular block. The model now correctly represents flow between the carbonate and alluvium/Carlin as an entirely vertical phenomenon.

- Another example is the connection between the Betze carbonate and the Leeville carbonate through the granodiorrite stock. The permeable window through the stock was moved from layers 1 and 2 to layer 3, correcting the sudden decrease in the connection that occurred when cells in the Betze carbonate became dry.

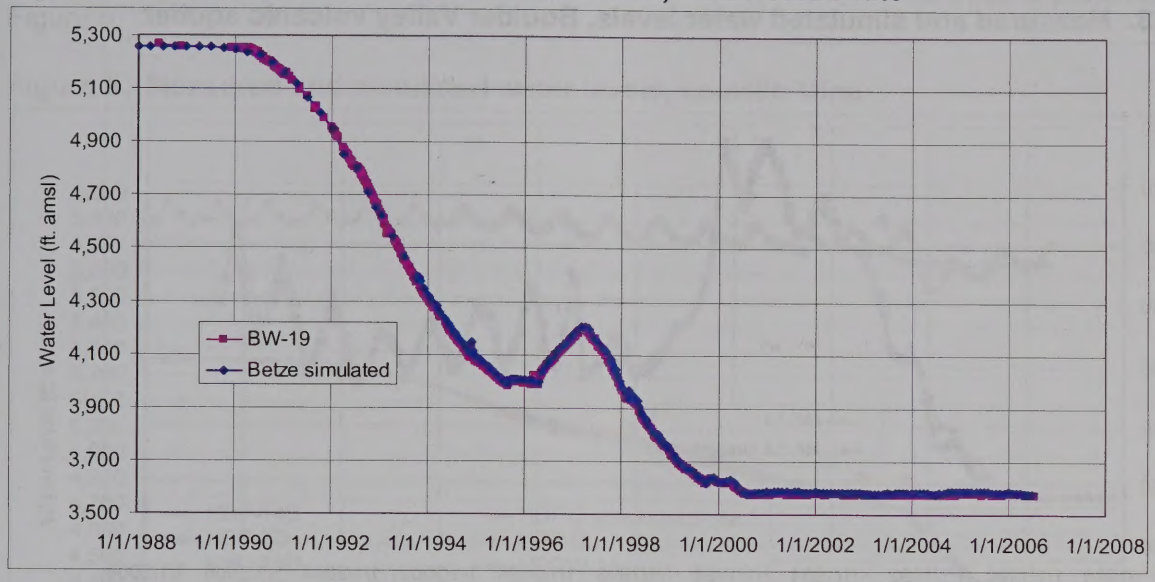
- Deeper dewatering scenarios resulted in the drying of layer 2 of the Betze carbonate aquifer, which substantially changed the model topology and yielded unrealistic results. The solution was to lower the bottom of layer 2 so that it would not become dry.

The currently model produces very similar results to the 2003 Betze Project SEIS model but has better accuracy.

Ongoing Calibration

Model calibration in the Betze carbonate aquifer has been refined several times, incorporating new water level and pumping data as the aquifer has been stressed down to the 3600 foot elevation (BGMI coordinate). The long term dewatering has continued to provide information about conductivity and storage at deeper levels within the carbonate and of conductivity and storage in hydrogeologic units farther away from the carbonate aquifer. The most recent calibration of the model to Betze carbonate pumping and water levels through June 2006 is presented in Figure 1.

Figure 1. Measured and simulated water levels, Betze carbonate



Model calibration to water levels in the volcanic aquifer and discharge from the Sand Dune Springs has been refined several times, incorporating new data as the injection of water at the TS Ranch Reservoir has continued. The most recent calibration of the model to Sand Dune springflow through June 2006 is presented on Figure 2, with calibration to the associated volcanic water levels presented in Figure 3.

Figure 2. Measured and simulated Sand Dune spring discharge

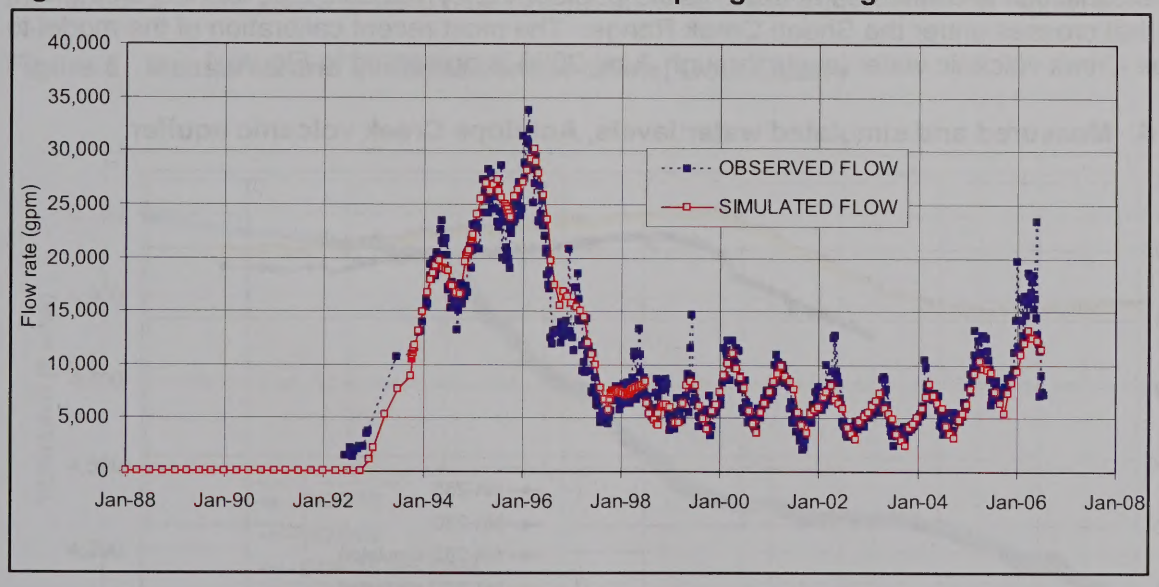
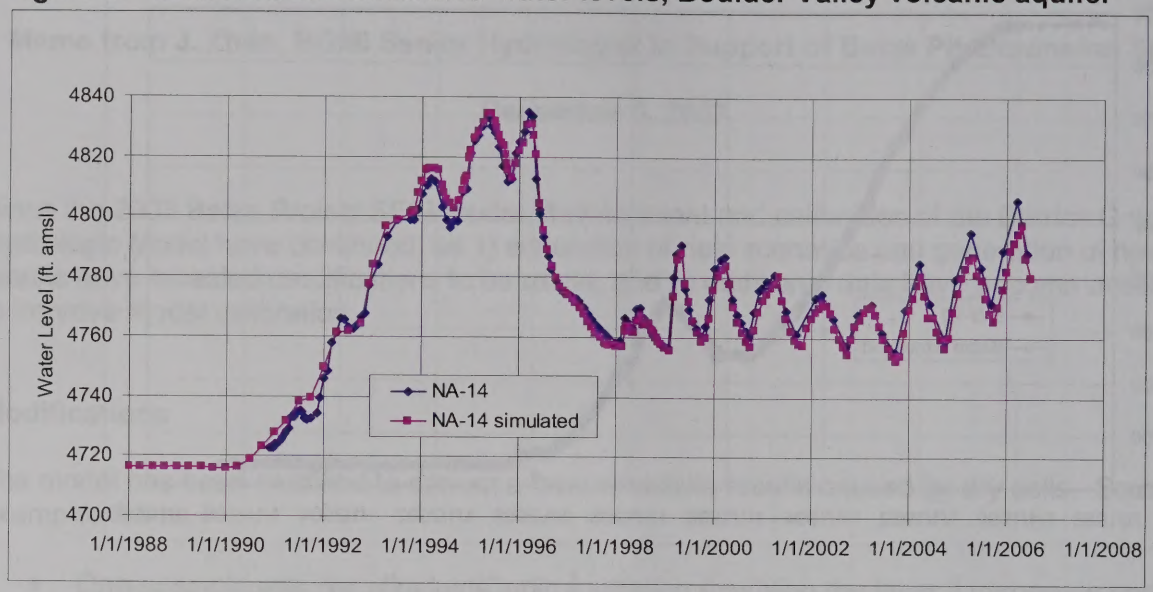
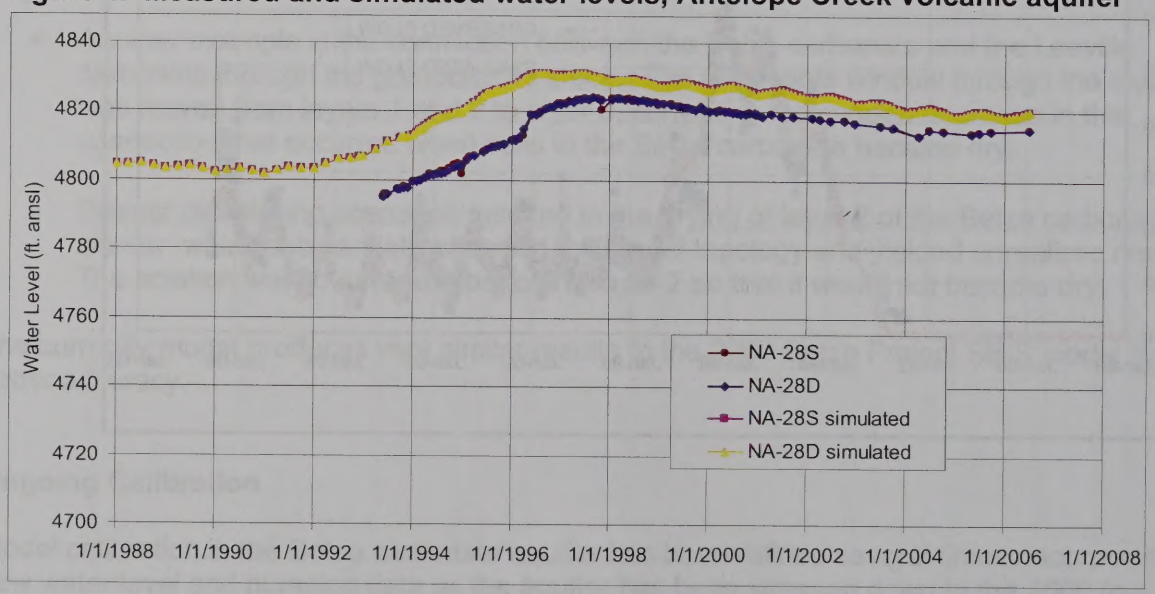


Figure 3. Measured and simulated water levels, Boulder Valley volcanic aquifer



The model has been refined and improved to the northwest of the Goldstrike Mine, toward Antelope Creek, as the complicated interrelation between the Betze carbonate, the Antelope Creek and Boulder Valley volcanic aquifers, and the perched aquifer has become better understood. The carbonate unit dips to the northwest and is overlain by the perched aquifer, coming into hydraulic connection with the volcanic aquifer near Antelope Creek. The Antelope Creek volcanic unit is connected at depth to the Boulder Valley volcanic unit, forming a single aquifer that crosses under the Sheep Creek Range. The most recent calibration of the model to Antelope Creek volcanic water levels through June 2006 is presented in Figure 4.

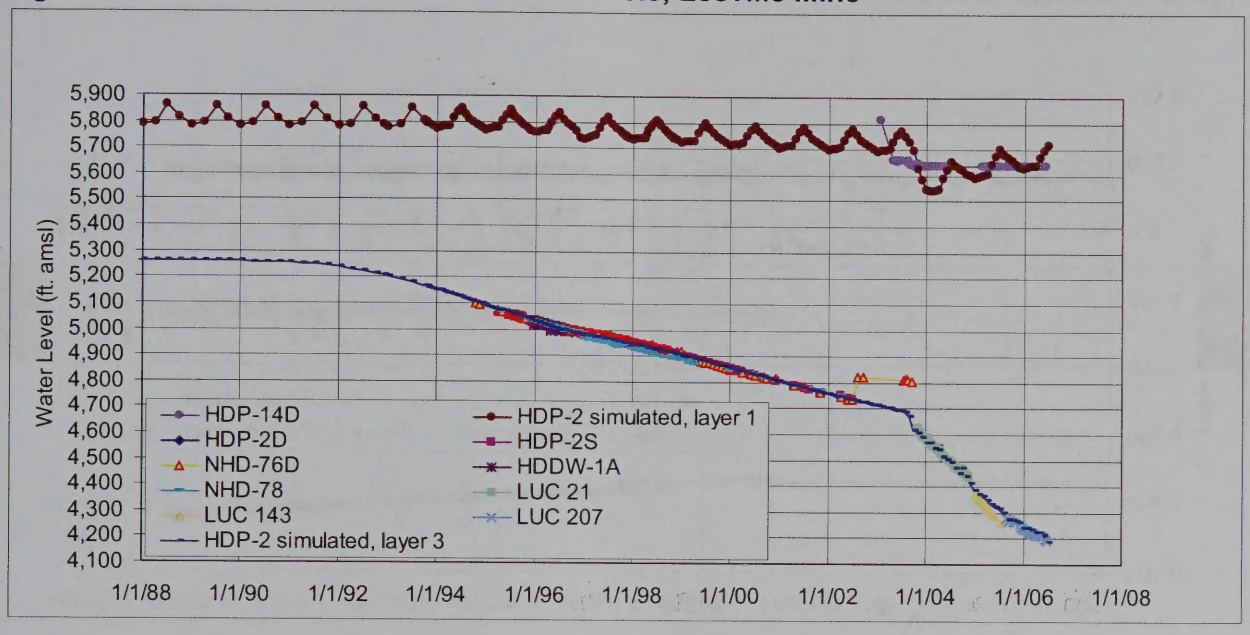
Figure 4. Measured and simulated water levels, Antelope Creek volcanic aquifer



The model has been further developed in the vicinity of the Leeville project as geological information and pumping and water level data have become available. The most recent

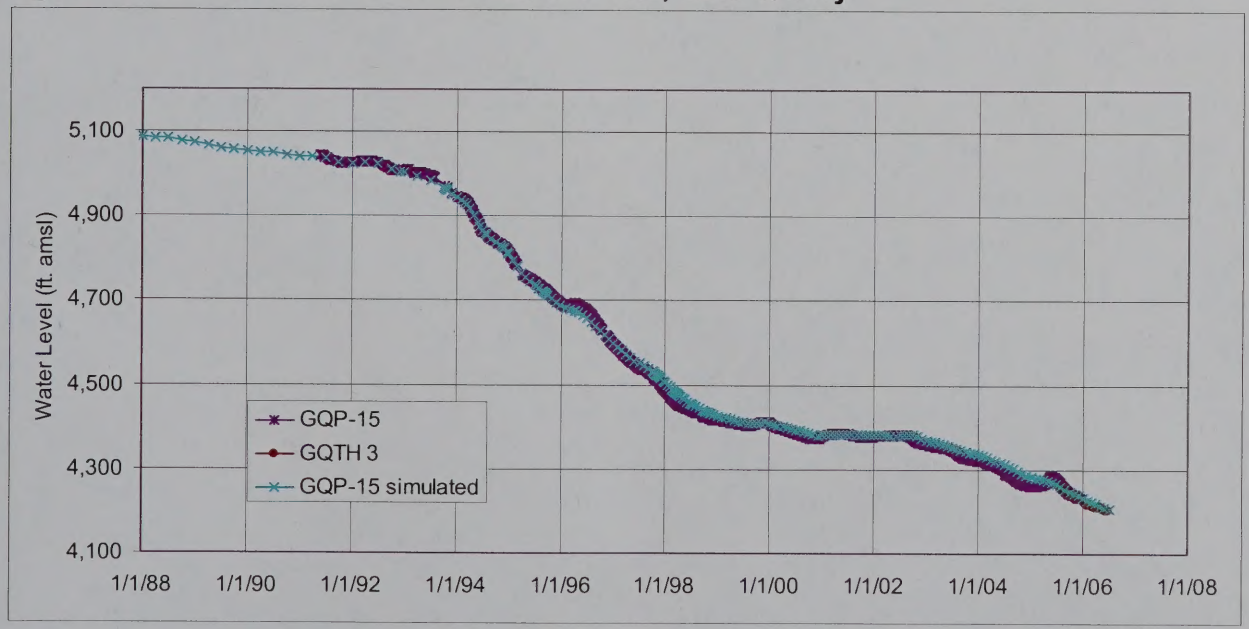
calibration of the model to water levels in the Leeville area through June 2006 is presented in Figure 5.

Figure 5. Measured and simulated water levels, Leeville Mine



The model calibration in the vicinity of Gold Quarry and in the Maggie Creek Basin has been improved, incorporating updated pumping and water level data. The most recent calibration of the model to water levels at Gold Quarry through June 2006 is presented on Figure 6.

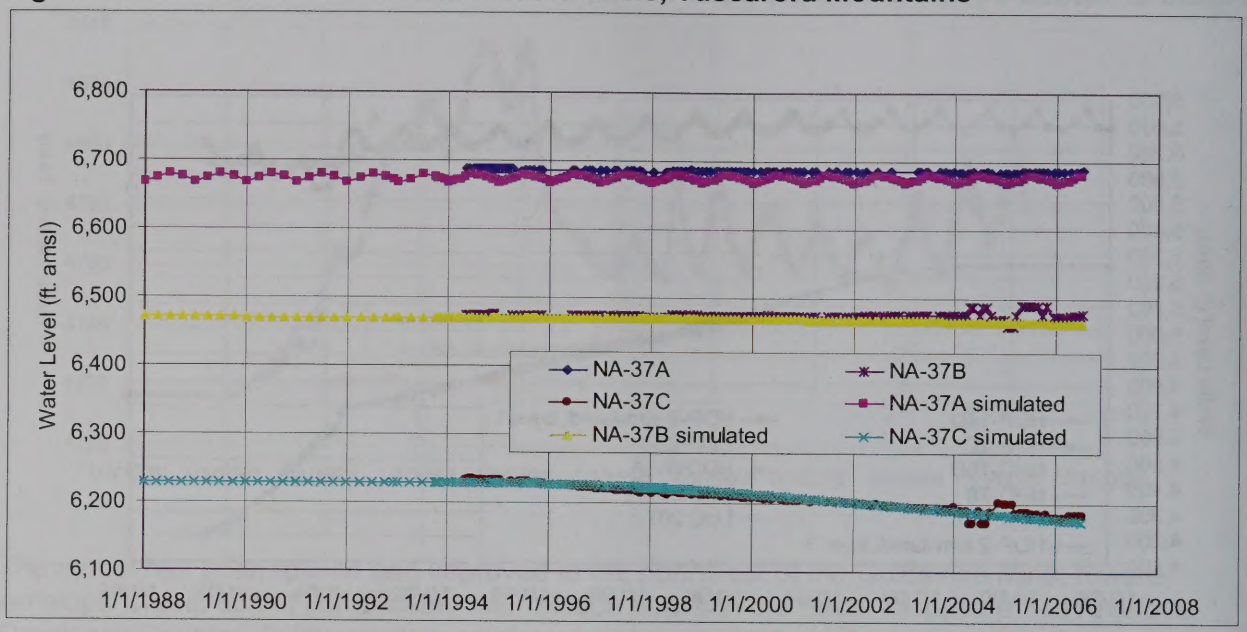
Figure 6. Measured and simulated water levels, Gold Quarry



Continued measurement of water levels in the Tuscarora Mountains has led to recalibration and improvement of the model in this area. The most recent calibration of the model to water levels

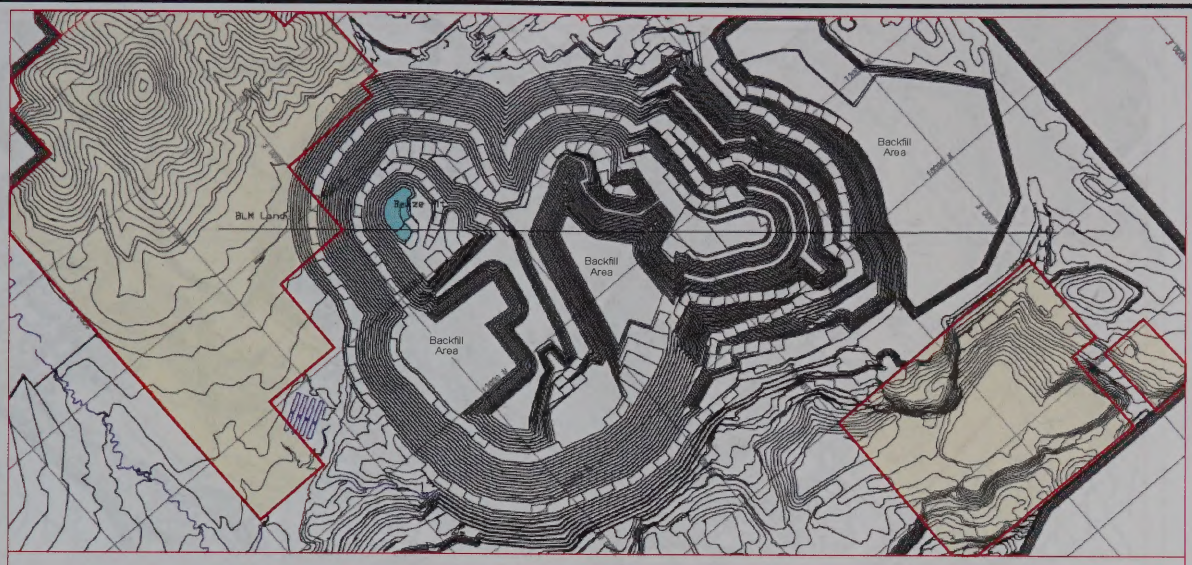
at the NA-37 piezometers in the Tuscarora Mountains, through June 2006, is presented on Figure 7.

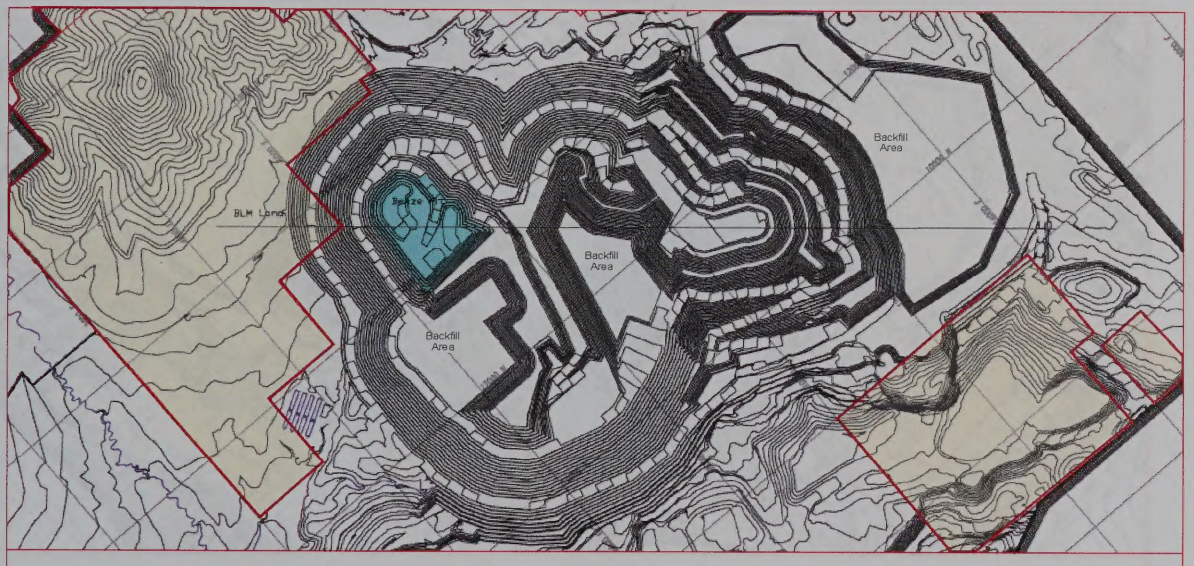
Figure 7. Measured and simulated water levels, Tuscarora Mountains



BETZE PIT LAKE FIGURES

APPENDIX C





Legend

- Inundated Areas of the Pit
- Publicly Owned (BLM) Land

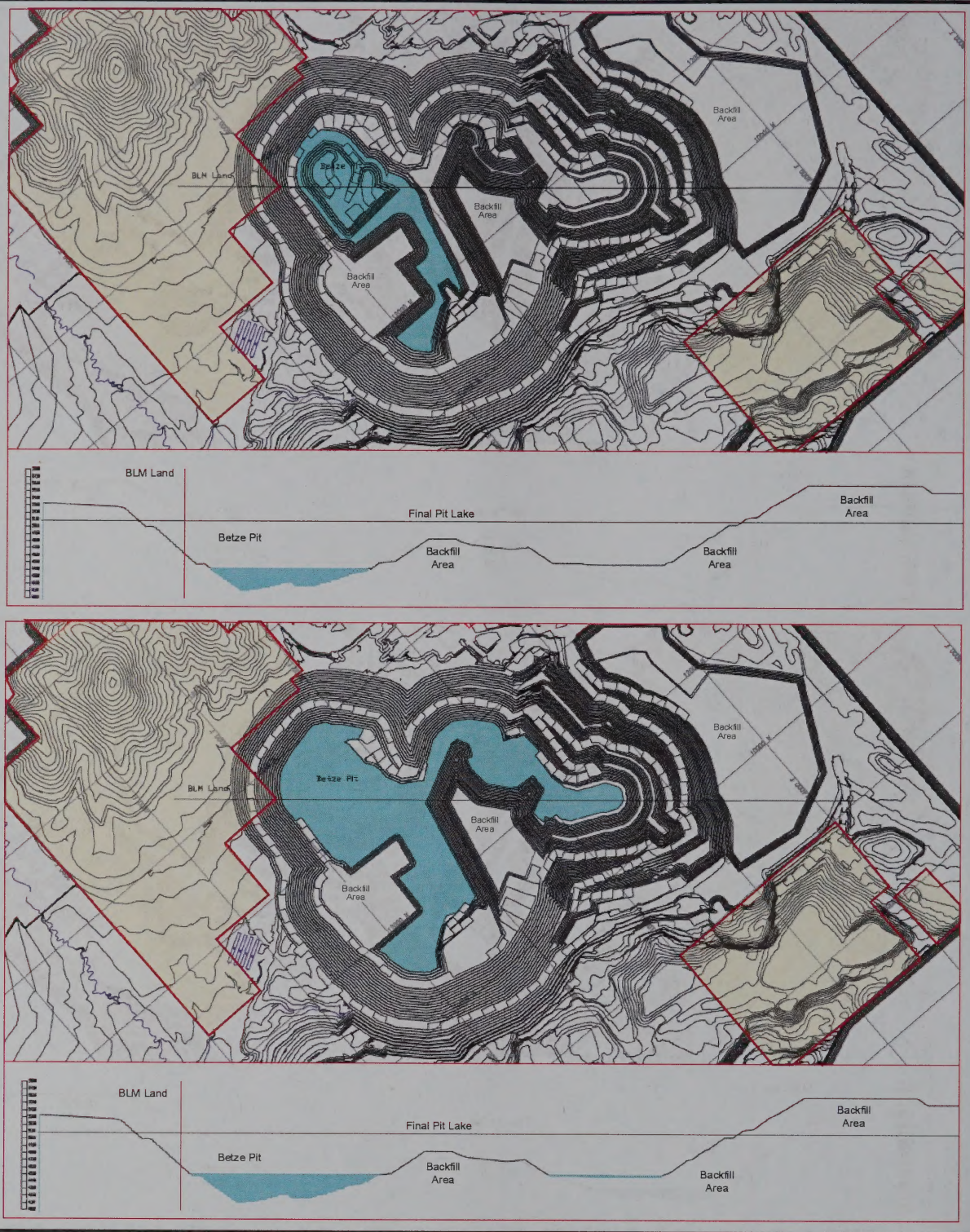
Source: Schafer 2008b.

Betze Pit Expansion Project

Figure C-1

Proposed Action
Betze Pit Lake
2025 (above), and
2035 (below)

06/16/08



Legend

- Inundated Areas of the Pit
- Publicly Owned (BLM) Land

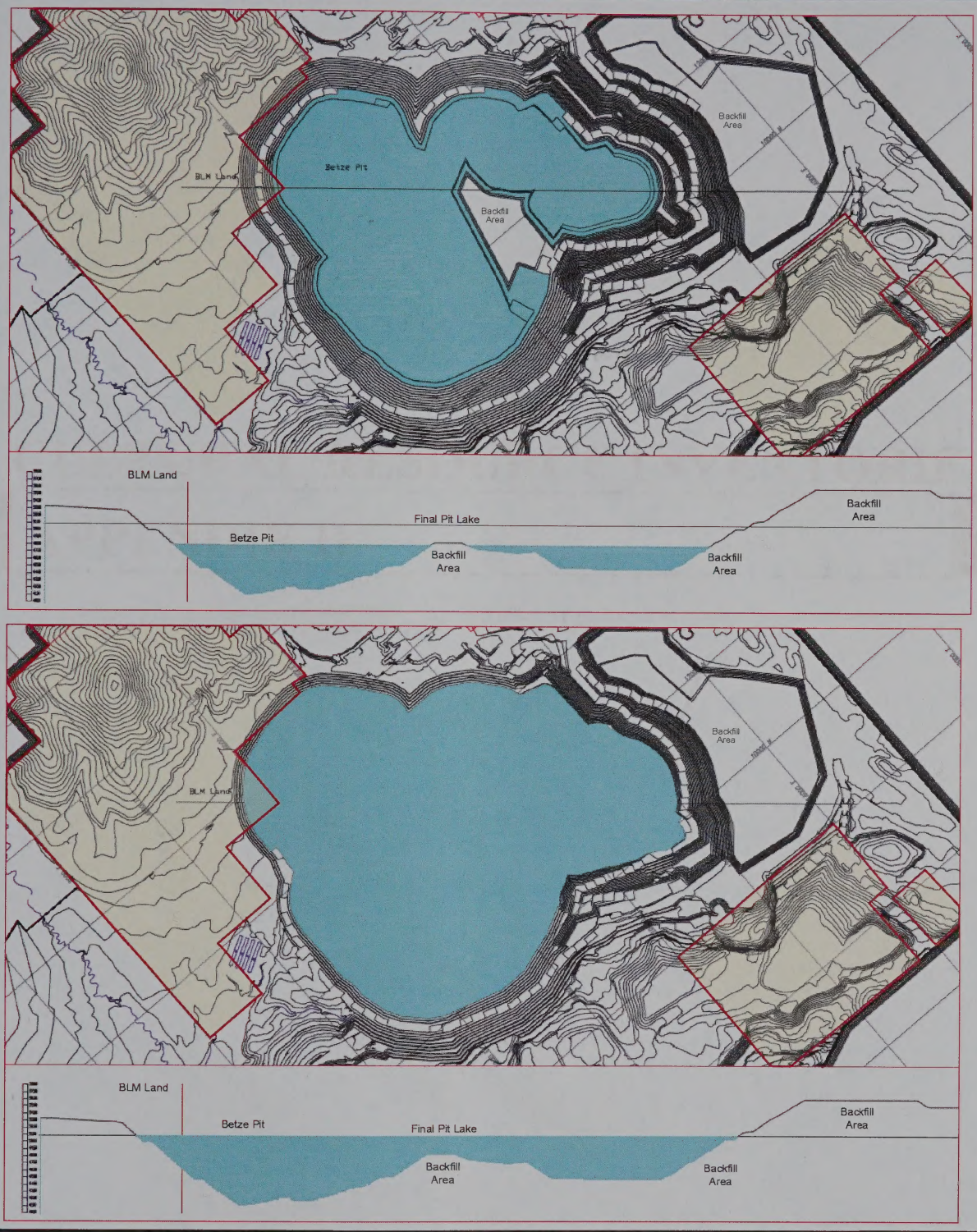
Source: Schafer 2008b.

Betze Pit Expansion Project

Figure C-2

Proposed Action
Betze Pit Lake
2045 (above) and
2065 (below)

06/16/08



Legend

- Inundated Areas of the Pit
- Publicly Owned (BLM) Land

Betze Pit Expansion Project

Figure C-3

Proposed Action
Betze Pit Lake
2115 (above) and
2415 (below)

Source: Schafer 2008b.

06/16/08



CULTURAL RESOURCE INVENTORIES

APPENDIX D

Table D-1 Cultural Resource Inventories Conducted in the Cumulative Effects Study Area

Mine Name	Report Title	Author, Date	BLM Report Number	Sites	National Register Eligibility Recommendation
Barrick Goldstrike Mines	Class III Cultural Resource Inventory in the Ranch Reservoir Area, Eureka County, Nevada	Tipps and Popek 1990	BLM 1-1287 (P)	**38 sites/isolates** CrNV-12-8005-8009, 8020-8029, 8040-49, 8060-69, 8080-8082	1 eligible site (8022)
Barrick Goldstrike Mines	Class III Cultural Resource Inventory of the Santa Fe Pacific Parcel, Eureka County, Nevada	Schroedl, A. 1990	BLM 1-1323 (P)	**15 sites/isolates** CrNV-12-8182-8189, 8200-8206	1 eligible site (8185)
Barrick Goldstrike Mines	Class III Cultural Resource Inventory of a Portion of Section 34, T. 36N, R. 49E, Eureka County, Nevada	Popek, G. 1990	BLM 1-1345 (P)	**5 sites** CrNV-12-7687, 12-8289, 12-8300, 12-8301, 12-7687	None are eligible
Barrick Goldstrike Mines/ Betze Project	An Assessment of National Register Eligibility of 29 Cultural Properties Recorded by Desert Research Institute and P-III Associates, Inc., in the Eastern Portion of the North Block of Barrick Goldstrike Mines, Inc.'s Betze Project, Little Boulder Basin Area, Eureka County, Nevada	Newsome, *et al.* 1992	BLM 1-1527 (P)	**29 sites** CrNV-12-7240 CrNV-12-7401, 7402 CrNV-12-7241, 7389 CrNV-12-7405, 7407 CrNV-12-7406, 7409 CrNV-12-7420 CrNV-12-7423, 7424 CrNV-12-7482 CrNV-12-7627 to 7629 CrNV-12-7640 to 7642 CrNV-12-7646, 7647 CrNV-12-7649 CrNV-12-7660 to 7661 CrNV-12-7663 to 7664 CrNV-12-7680 CrNV-12-10507 CrNV-12-10545	Eligible Eligible Not Eligible Eligible Not Eligible Eligible Not Eligible Not Eligible Not Eligible Not Eligible Not Eligible Not Eligible Not Eligible Not Eligible Not Eligible Eligible Eligible
Barrick Goldstrike Mines/Betze Project	Site Specific Data Recovery Plans for Seven Historic Properties in the Heap Leach Facility Area of the Betze Project, Little Boulder Basin Area, Nevada	Zeanah, D. *et al.* 1992	BLM 1-1548	**7 sites** CrNV-12-5681, 5682 CrNV-12-7381, 7382 CrNV-12-7404 CrNV-12-8928, 8929	All eligible
Barrick Goldstrike Mines/Little Boulder Basin	Cultural Resource Inventory and Testing in Little Boulder Basin, Eureka County, Nevada: Final Report	Russell, *et al.* 1986	BLM 1-1042	**44 sites** CrNV-12-5627-5629, 5640-5649, 5660-5663, 5683-5689, 5700-5709, 5720-5729	4 potentially eligible sites
Barrick Goldstrike Mines/Little Boulder Basin	Site Specific Data Recovery Plan for Six Historic Properties in the North Block Tailings Disposal Facility Area, Phase II, Little Boulder Basin, Nevada	Jones, *et al.* 1994	BLM 1-1684 (P)	**6 sites** 26EU1482/1906 26EU1530, 26EU1534, 26EU4696, 26EU5374, CrNV-12-8926	All eligible

Table D-1 Cultural Resource Inventories Conducted in the Cumulative Effects Study Area

Mine Name	Report Title	Author, Date	BLM Report Number	Sites	National Register Eligibility Recommendation
Barrick Goldstrike Mines	Archaic and Numic Encampment in the Little Boulder Basin, Eureka County, Nevada	Tipps 1988	BLM 1-1188 (P)	**2 sites** 26EU1319 26EU1320	Eligible, mitigated Eligible, tested
Barrick Mine	A Cultural Resources Survey of the Barrick Mine 120 kV Transmission Line Project in Eureka County, Nevada for Sierra Pacific Power Company	Johnson, F. 1987	BLM 1-1126 (P)	**2 sites** CrNV-12-6382 CrNV-12-6383	Not eligible
Barrrick Goldstrike Mines/Little Boulder Basin	Cultural Resource Inventory, Monitoring, and National Register Evaluations in the Little Boulder Basin Area, Nevada	Schroedl and Tipps 1991	BLM 1-1342 (P)	**27 sites/7 isolated finds** CrNV-12-8922-8929 CrNV-12-8940-8949 CrNV-12-7408 (EK1482) CrNV-12-7421 (EK1483) CrNV-12-7326 (EU1484) CrNV-12-7328 (EU1485) CrNV-12-7344 (EU1486) CrNV-12-7345 (EU1487) CrNV-12-7361 (EU1488) CrNV-12-7365 (EU1489) CrNV-12-7366 (EU1490) CrNV-12-7385 (EU1491) CrNV-12-7440 (EK1492) CrNV-12-7400 (EK4687) CrNV-12-7228 (EK4688) CrNV-12-7403 (EK4689) CrNV-12-7229 (EK4690)	17 eligible sites (CrNV-12-8249, 8923, 8926, 8928, 8929, EUI482-1484, EUI486, EUI487, EUI489-1492, EK4687, EK4688, EK4690)
Betze Project	Cultural Resources Technical Report for the Betze Pit Expansion Project Environmental Impact Statement, Eureka and Elko Counties, Nevada	Burke, T. 1990	BLM 1-1760	**75 sites/isolates total** CrNV-12 5585-5589, 5600, 5661-5669, 5627-5629, 5640-5647, 5680-5686, 5701-5706, 7303-7309, 7320-7327, 7369, 7381-7384, 7389, 7400-7409, 7229, 7240, 7420-7429, 7440-7446, 7468, 7481-7482	1 eligible site (5682); 37 ineligible, 37 unevaluated
Carlin Gold Mine	Report on an Archaeological Reconnaissance in the Vicinity of James Creek, Eureka County, Nevada	Clerico, R. 1983	BLM 1-682 (P)	**17 sites/ 10 isolated finds** CrNV-12-3281 through 3289, 12-3300-3309, 3320-3327	12 ineligible, 9 mitigated, 6 unevaluated (see BLM I-727)
Carlin Gold Mine	An Evaluation of Six Archaeological Sites in the James Creek Vicinity, Eureka County, Nevada	Clerico, *et al.* 1983	BLM 1-727 (P)	**6 sites** CrNV-12-3285 (EU839); CrNV-12-3304 (EU840); CrNV-12-3305 (EU841); CrNV-12-3309 (EU842); CrNV-12-3320 (EU843-James Creek Shelter); CrNV-12-3326 (EU844)	All eligible

Table D-1 Cultural Resource Inventories Conducted in the Cumulative Effects Study Area

Mine Name	Report Title	Author, Date	BLM Report Number	Sites	National Register Eligibility Recommendation
Carlin Gold Mine	Nevada Department of Transportation Cultural Resources Report SR766 Elko/Eureka County Line to the Carlin Gold Mine	Mathiesen, D. and P. Matranga, 1985	BLM 1-967 (P)	26EU1270	Not eligible
Carlin Gold Mine	Proposed Data Recovery Activities at the James Creek Shelter (26EU843), Eureka County, Nevada	Elston and Budy 1984	BLM 1-1584 (P)	**1 site** CrNV-12-3320	Eligible, mitigated
Dee Gold Mine	Archaeological Report on the Evaluation of Sites CrNV-12-1986 to 1989 and CrNV-12-2000 to 2004, the Dee Gold Mine, Elko County, Nevada	Ellis, R. 1983	BLM 1-709 (P)	**9 sites** CrNV-12-1986 to1989; CrNV-2000 to 2004	8 ineligible; 12-2004 unevaluated
Dee Gold Mine	Cultural Resource Inventory of a 520 Acre Mining Exploration Area and an Access Road for Dee Gold Mining Company, in the Tuscarora Mountains, Elko County, Nevada	Rafferty, K. and L. Blair 1988	BLM 1-1203 (P)	**5 sites/ 2 isolates** no site numbers	6 ineligible; 1 eligible
Dee Gold Mine	A Cultural Resources Inventory of a 5800' Diversion Ditch for Dee Gold Mining Company in Elko County, Nevada	Johnson, F. 1991	BLM 1-1407 (P)	**2 sites** CrNV-12-8441 and 12-8442	Not eligible
Dee Gold Mine	A Cultural Resources Inventory of The Waste Dump Expansion Project for Dee Gold Mining Company in Elko County, Nevada	Johnson, F. 1991	BLM 1-1408 (P)	**4 sites** CrNV-12-8445 to 8447 and EK4831	1 eligible site (EK4831)
Dee Gold Mine	A Reevaluation of Cultural Resources in the Dee Gold Mining Company Waste Dump Expansion Area, Elko County, Nevada	Tipps and Popek 1991	BLM 1-1485 (P)	**28 sites/38 isolated finds** CrNV-12-10440 to 10449, 10460 to 10469, 10480 to 10487	10 eligible sites (CRNV-12-10440, 10441, 10444, 10449, 10462, 10464, 10465, 10484, 10486, 10487)
Dee Gold Mine	Dee Gold Expansion Project: A Reevaluation of 130 Acres at the Dee Gold Mine in Elko County, Nevada	Newsome, *et al.* 1992	BLM 1-1521 (P)	**7 sites** CrNV-12-8729 CrNV-12-10529 CrNV-12-10540, 10543 CrNV-12-10541, 10542 CrNV-12-10544	Eligible Eligible Eligible Not Eligible Not Eligible
Newmont Gold Lower James Creek Area	Class III Cultural Resource Inventory of the Lower James Creek Area, Section 12, T. 33N, R. 51E, Eureka County, Nevada	Popek and Strand 1990	BLM 1-1324 (P)	2 isolated finds	Not eligible

Table D-1 Cultural Resource Inventories Conducted in the Cumulative Effects Study Area

Mine Name	Report Title	Author, Date	BLM Report Number	Sites	National Register Eligibility Recommendation
Newmont Gold Lower James Creek Area	Class III Cultural Resource Inventory of the Lower James Creek Area, Section 14, T. 33N, R. 51E, Eureka County, Nevada	Popek and Schroeld, 1990	BLM 1-1340 (P)	**4 sites** CrNV-12-8245-8248	None eligible
Newmont Gold	Test Hole and Access Road for Newmont Gold Company, Elko County, Nevada	Brewster, M. 1990	BLM 1-1480 (P)	CrNV-12-8325; CrNV-12-3283	Unevaluated
Newmont Gold	A Cultural Resources Inventory of 60 AC of the Lorri/KL Claim and 5.5 Miles of Linear Transect for a Proposed Pipeline for Newmont Exploration Limited in Eureka County, Nevada	Hause, L. 1991	BLM 1-1501 (P)	**3 sites** CrNV-12-10422-10424	None eligible
Newmont-Blue Star/Genesis Mine (EA filed 1989)	A Class III Cultural Resources Inventory for the Genesis Blue Star Project, Eureka County Nevada. P-III Associates, Inc.	Birnie, Robert I. 2006	BLM 1-2528(P)	**12 sites** CRNV-12-7160 CRNV-12-10565 CRNV-12-13732 CRNV-12-13733 CRNV-12-13734 CRNV-12-13735 CRNV-12-13736 CRNV-12-13737 CRNV-12-13738 CRNV-12-13739 CRNV-12-13740 CRNV-12-13741	1 site: CRNV-12-10565
Newmont Mine Leeville Pipeline	Cultural Resource Inventory of Alternative Routes for the Proposed Leeville Dewatering Pipeline, Eureka County, Nevada	Newsome, Daniel K. 2000	BLM 1-1652 (P)	CRNV-12-7162 CRNV-12-10801	1 eligible site (10801)
Newmont-Mike Exploration Project	Class III Cultural Resource Inventory of the Mike Addition, Eureka County, Nevada. BLM report 1-2510(P), P-III Associates, Inc. Salt Lake City, Utah.	Bright, J.R. 2006	BLM 1-2510(P)	**6 sites** CRNV-12-13647 CRNV-12-13648 CRNV-12-13649 CRNV-12-13650 CRNV-12-13651 CRNV-12-13652	3 eligible sites CRNV-12-13650 CRNV-12-13651 CRNV-12-13652
Newmont Mine	Reassessment of Site Significance for CRNV-12-10801. BLM Elko Field office	Hockett, Bryan 2006	1-2555(P)	CRNV-12-10801	Eligible

Table D-1 Cultural Resource Inventories Conducted in the Cumulative Effects Study Area

Mine Name	Report Title	Author, Date	BLM Report Number	Sites	National Register Eligibility Recommendation
Newmont-Pete Project	Class III Cultural Resource Inventory of the Pete Addition, Eureka County, Nevada. BLM report 1-1935(P), P-III Associates, Inc. Salt Lake City, Utah.	Newsome, Daniel K. 2000	BLM 1-1935(P)	**6 sites** CRNV-12-11424 CRNV-12-11425 CRNV-12-11427 CRNV-11-10038 CRNV-11-10039 CRNV-11-10050	1 eligible site CrNV-11-11039
Newmont Mine South Operations Area	A Class III Cultural Resources Inventory of 837 Acres in Newmont Mining Corporation's South Operations Area, Elko and Eureka Counties, Nevada	Birnie and Knoll 2006	BLM 1-2397 (P)	**9 sites** CRNV-12-11507 CRNV-12-11508 CRNV-12-13293 CRNV-12-13294 CRNV-12-13295 CRNV-12-13296 CRNV-12-13297 CRNV-12-13298 CRNV-12-13299	4 eligible sites CRNV-12-11507 CRNV-12-13293 CRNV-12-13294 CRNV-12-13296
Newmont Mine South Operations Area	South Operations Area Project Amendment (SOAPA) (EIS filed 2002)			**53 sites total**	8 eligible sites CRNV-11-9292 CRNV-11-9293 CRNV-11-9294 CRNV-11-9279 CRNV-11-9290 CRNV-11-9291 CRNV-12-3320
Newmont-High Desert (EA filed 1992)	A Treatment Plan for Historic Site 26EU2505, North-Central Nevada. P-III Associates, Inc. Salt Lake City, Utah.	Schroedl 2006	BLM 1-2530(P)	CRNV-12-12466	Eligible
Newmont Gold Chevas Parcel	Cultural Resource Inventory of the Chevas Parcel, Eureka County, Nevada	Newsome, D. 1992	BLM 1-1628 (P)	**18 sites** CRNV-12-1840, 6381, 6989, 11063-11069, 11080-11087	None eligible
Newmont Gold	Cultural Resource Inventory and Testing in Section 3, T. 35 N, R. 50 E, Eureka County, Nevada	Stratford, Mary 1996	BLM 1-1636	**10 sites** 5073-1 through 5073-10	All not eligible
Newmont Gold Bootstrap/Capstone Area	Site-Specific Data Recovery Plan for Five Prehistoric Cultural Properties in the Bootstrap/Capstone Project Area, Upper Boulder Valley, Nevada	Jones, *et al.* 1996	BLM 1-2024 (P)	**5 sites** CrNV-12-7345 (EU1487) CrNV-12-7440 (EU1492) CrNV-12-7940 CrNV-12-7368 CrNV-12-7364	All eligible

Table D-1 Cultural Resource Inventories Conducted in the Cumulative Effects Study Area

Mine Name	Report Title	Author, Date	BLM Report Number	Sites	National Register Eligibility Recommendation
Newmont Gold Carlin Operations Area	Cultural Resource Inventory of a Fence Corridor Near the Carlin Operations Area in Eureka County, Nevada	Newsome, D. 1996	BLM 1-2027 (N)	None	
Newmont Gold South Operations Area	A Class III Cultural Resource Inventory of Newmont Gold Company South Operations Area Eureka County, Nevada	Lennon, T. and R. Peterson 1991	BLM 1-1403 (P)	26EU1660	Not eligible
Newmont Gold South Operations Area	Cultural Resources Inventory of Miscellaneous Parcels in the Gold Quarry South Operations Area, Elko and Eureka Counties, Nevada	Tips and Newsome 1993	BLM 1-1746 (P)	**1 isolated find**	Not eligible
Newmont Gold South Operations Area	Cultural Resources Inventory of the GQX Parcels and Summary of the South Operations Area Project, Elko and Eureka Counties, Nevada	Newsome, D. and Tipps 1997	BLM 1-1651	**17 sites** CrNV-12-3283 CrNV-11-9292 CrNV-11-9293 CrNV-11-9294 CrNV-12-8325 CrNV-11-9276 CrNV-11-9277 CrNV-11-9278 CrNV-11-9295 CrNV-11-9296 CrNV-11-9297 CrNV-11-9298 CrNV-11-9299 CrNV-11-9310 CrNV-11-9279 CrNV-11-9290 CrMV-11-9291	 Eligible Eligible Eligible Eligible Not Eligible Not Eligible Not Eligible Not Eligible Not Eligible Not Eligible Not Eligible Not Eligible Not Eligible Not Eligible Unevaluated Unevaluated Unevaluated
Newmont Mine Mill No. 4	Cultural Resource Inventory of the No. 4 Mill Project, Eureka County, Nevada	Burke, T. 1988	BLM 1-1142 (P)	**4 sites** CrNV-6387 through 6389, 6400	None are eligible
Newmont Mine Bluestar Operations	A Cultural Resources Survey of the Bluestar Operations Area in Eureka County, Nevada, for Newmont Gold Company	Johnson, F. 1988	BLM 1-1209 (P)	**11 sites** CrNV-1838 CrNV-1839 B-1 through B-9	 Unevaluated Not eligible Not eligible
Newmont Mine Tusc-Mac Area	Cultural Resource Inventory of the Tusc-Mac Area, Eureka County, Nevada	Tipps, B. *et al.* 1990	BLM 1-1341 (P)	**12 sites** CrNV-12-8260 through CrNV-12-8269, CrNV-12-8280, 8281	Not eligible
Newmont Mine	The Newmont Rodeo Creek Survey: Class III Cultural Resource Inventory of a Portion of Section 19, T. 36N, R. 50E, and a Portion of Section 24, T. 36N, R. 49E, Eureka County, Nevada	Tipps, B. *et al.* 1991	BLM 1-1509	**7 sites** 26EU1320 26EU1734 26EU1785-1789	4 eligible sites (EU1320, EU1734, EU1785, EU1786)

Table D-1 Cultural Resource Inventories Conducted in the Cumulative Effects Study Area

Mine Name	Report Title	Author, Date	BLM Report Number	Sites	National Register Eligibility Recommendation
Newmont Mine	Class III Cultural Resource Inventory of Portions of Sections 17, 18, 19, 20, and 30, T. 36N, R. 50E, Eureka County, Nevada	Newsome, D. *et al.* 1993	BLM 1-1684 (P)	**6 sites** CrNV-12-5585 CrNV-12-5681 (EU1734) CrNV-12-10546 (EU1785) CrNV-12-11260 to 11262	Not eligible Eligible Eligible Not eligible
Newmont Mine Carlin Trend	Cultural Resource Inventory of the Carlin Trend and Valmy Trend Land Exchange Parcels, Elko, Eureka, and Humboldt Counties, Nevada	Newsome *et al.* 1998	BLM 1-1774 (P)	**36 sites/isolates total** CrNV-12-11028, 12-11029, 12-11040-11048, 11022-11027, 11047-11048, 11-9078, 11-9098-9099, 11-9110-9113, 12-8245-8247, 12-11344-11349, 12-11360-11362, 12-9776-9779, 12-9790-9791	5 eligible sites (12-11043, 11-9098, 11-9099, 11-9110, 11-9111)
Newmont Mine	Additional Cultural Resource Inventory of the Newmont Gold Company Mill Ore Haul Road and a Portion of the Maggie Creek Drainage, Eureka and Elko Counties, Nevada	Kenzle, S. 1993	BLM 1-1807 (P)	**4 sites** CrNV-12-11722 CrNV-12-11723 CrNV-12-11724 CrNV-12-11725	Not eligible Eligible Not eligible Eligible
Newmont Mine	Cultural Resource Inventory of the Newmont Gold Company Diversion Channel Extension in Eureka County, Nevada	Kenzle, S. 1994	BLM 1-1888 (N)	None	
Newmont Mine	Cultural Resource Inventory of Section 9, Township 35N, Range 50E, Eureka County, Nevada	Kenzle, S. 1994	BLM 1-1942 (P)	CrNV-12-12023 CrNV-12-12024	Not eligible
Newmont Mine	Cultural Resources Inventory of the Boulder Creek and Dunphy Road Realignment Project Area, Elko County, Nevada	Jones 1994	BLM 1-1947	**3 sites** 5050-1 and 5050-2 CrNV-12-10448	Eligible Eligible
Newmont Mine	Newmont Explorations Bell Creek Project Cultural Resources Report	Spencer 1985	BLM 1-947 (P)	CrNV-12-5004	Not eligible
Newmont Mine Bootstrap Area	Class II and III Cultural Resource Inventory in the Bootstrap Operations Area, Elko and Eureka Counties, Nevada	Tipps, B. 1989	BLM 1-1268 (P)	**83 sites/isolated finds** CrNV-12-7965, 7920-7921, 01-7103, 12-7922-7929, 7940-7949, 7960-7964, 7805-7809, 7820-7829, 7840-7849, 7860-7869, 7871, 7880-787889, 7900-7909	3 eligible sites (CrNV-I-7103, 12-7921, 12-7940)
Newmont Mine Bootstrap/ Capstone Area	Cultural Resource Inventory of Private Lands in the Bootstrap/Capstone Area, Elko and Eureka Counties, Nevada	Newsome, D. 1995	BLM 1-1988 (P)	**60 sites total** CrNV-12-2004 CrNV-12-7103	Not Eligible Eligible

Table D-1 Cultural Resource Inventories Conducted in the Cumulative Effects Study Area

Mine Name	Report Title	Author, Date	BLM Report Number	Sites	National Register Eligibility Recommendation
				CrNV-12-7360	Not Eligible
				CrNV-12-7364	Eligible
				CrNV-12-7368	Eligible
				CrNV-12-7447	Eligible
				CrNV-12-7842	Not Eligible
				CrNV-12-7861	Not Eligible
				CrNV-12-7888	Not Eligible
				CrNV-12-7903	Not Eligible
				CrNV-12-7921	Eligible
				CrNV-12-7924	Eligible
				CrNV-12-7929	Not Eligible
				CrNV-12-7941	Not Eligible
				CrNV-12-7960	Not Eligible
				CrNV-12-7962	Not Eligible
				CrNV-12-7964	Not Eligible
				CrNV-12-8783	Not Eligible
				CrNV-12-8923	Eligible
				CrNV-12-10448	Eligible
				CrNV-12-10486	Eligible
				CrNV-12-11166	Eligible
				CrNV-12-11167	Not Eligible
				CrNV-12-11600	Not Eligible
				CrNV-12-11626-11627	Eligible
				CrNV-12-11640	Not Eligible
				CrNV-12-11641	Eligible
				CrNV-12-11644-11645	Eligible
				CrNV-12-11649	Not Eligible
				CrNV-12-11660	Not Eligible
				CrNV-12-11664	Not Eligible
				CrNV-12-12026-12027	Eligible
				CrNV-12-12245-12247	Not Eligible
				CrNV-12-12248	Eligible
				CrNV-12-12249	Not Eligible
				CrNV-12-12260	Not Eligible
				CrNV-12-12261	Eligible
				CrNV-12-12262	Eligible
				CrNV-12-12263-12264	Not eligible
				CrNV-12-12265-12266	Eligible
				CrNV-12-12267-12269	Not eligible
				CrNV-12-12280	Eligible
				CrNV-12-12281-12285	Not eligible
				CrNV-12-12286-12289	Eligible
Newmont Mine/ Blue Star Area	Cultural Resource Evaluation of the Blue Star Mine Area in Eureka County, Nevada	Stratford, M. 1994	BLM 1-1944 (N)	None	

Table D-1 Cultural Resource Inventories Conducted in the Cumulative Effects Study Area

Mine Name	Report Title	Author, Date	BLM Report Number	Sites	National Register Eligibility Recommendation
	Right-of-Way for Powerline, Sierra Pacific Power	Dailey, R. T. 1987	BLM 1-1089 (P)	CrNV-6146, 6147	Not eligible
	Archaeological Survey of Access Roads to the Barrick 120 kV Powerline Right-of-Way for Sierra Pacific Power Company	Hubbard, T. 1988	BLM 1-1148 (N)	None	
	Archaeological Survey of Sierra Pacific Power Company's Proposed Ivanhoe 120 kV Extension	McLane, A. 1988	BLM 1-1240 (P)	**29 sites** (no site numbers)	11 potentially eligible
	Archaeological Inventory of Santa Fe Pacific Mining Company's Proposed Boulder Valley Exploration/Access Road	Young, B. 1989	BLM 1-1248 (P)	CrNV-12-7682, 7683, 7685-7688	None eligible
	Cultural Resource Inventory of Four Road Corridors in the Kinsley Mountains, Elko County, Nevada	Newsome, D. 1992	BLM 1-1290 (N)	None	
	The Schroeder Mountain Road Survey, Cultural Resources Report	Popek and Tipps 1991	BLM 1-1505 (N)	None	
	An Archaeological Survey for the Proposed 120 kV Transmission Line From Coyote Creek to Bazza, Elko and Eureka Counties, Nevada	Botti, *et al*, 1992	BLM 1-1520 (P)	**17 sites total** CrNV-12-273/7728 CrNV-12-292 CrNV-12-1736 CrNV-12-4060 CrNV-12-4063-4064 CrNV-12-7443 CrNV-12-10509 CrNV-12-10520-10528	Unknown
	Cultural Resources Inventory Report for a Sierra Pacific Power Co. Transmission Line	Kautz, 1992	BLM 1-1687 (P)	CrNV-12-7360, 7962	Not eligible
	Cultural Resource Inventory of the Maggie Creek Pipeline and Reservoir Area, Eureka and Elko Counties, Nevada	Kice, D. 1992	BLM 1-1722	**6 sites** CrNV-12-11504-11509	1 eligible site (12-11507)
	An Archaeological Inventory of a Proposed 345/120 kV Transmission Line Between the Valmy, Falcon, an Bell Creek stations in Humboldt, Lander, and Eureka Counties, Nevada	Mariah Associates Inc.	BLM 1-1788 (P)	**16 sites** CrNV-12-11561-11569, 11580-11584, 11586, CrNV-21-5846	None eligible
	Cultural Resource Monitoring of Six Exploration Drill Sites and an Associated Access Road in Section 12, T. 35N, R. 50E, Eureka County, Nevada	Newsome, D. 1994	BLM 1-1946 (N)	None	

Table D-1 Cultural Resource Inventories Conducted in the Cumulative Effects Study Area

Mine Name	Report Title	Author, Date	BLM Report Number	Sites	National Register Eligibility Recommendation
	Cultural Resources Report for the T Lazy S/25 Corporation Allotment Boundary Fences	King and Vance 1980	BLM 1-284 (P)	CrNV-01-1530	Unevaluated
	Proposed Underground Telephone Cable, Nevada Bell, Cultural Resources Report	Nelson, K. 1980	BLM 1-330 (N)	None	
	Cordex Mining Plan of Operations Cultural Resource Report	Jaynes, S. 1981	BLM 1-484 (P)	**9 sites** CrNV-12-1986 to1989; CrNV-2000 to 2004	4 potentially eligible sites
	A Cultural Resource Inventory of the Elko to Carlin Transmission Line, Elko County, Nevada	Gallagher, *et al.* 1982	BLM 1-642 (P)	**2 sites** (No Site numbers)	Unevaluated
Western States Minerals	Cultural Resource Inventory in the Little Boulder Basin, Eureka County, Nevada	Schroedl 1986	BLM 1-1040 (P)	**6 sites** WSM-1 WSM-2 WSM-3 WSM-4 WSM-5 WSM-6	 Unevaluated Unevaluated Unevaluated Unevaluated Unevaluated Unevaluated

Source: http://www.blm.gov/pgdata/etc/medialib/blm/nv/field_offices/elko_field_office/programs/nepa/appendices_for_the.Par.3480.File.dat/APPENDIX%20C.pdf

Table D-2 List of Damaged Archaeological Sites within the Barrick Goldstrike POO Boundary[1]

Mining Damaged Sites	BLM Number CrNV-12-	BLM 1- Project Number	NRHP Eligibility
EK4740	7103	1203/1268/ 1988	Eligible
EK4659/ EK5914	11166	1202/1642/ 1649	Eligible
EU1485	7328	P-III	Not eligible
EU1486	7344	1244/1342/ 1523/1643	No longer eligible
EU1488	7361	PIII	Eligible site
EU1490	7366	1244/1342/ 1523	Eligible – Surface Collected by P-III & SWCA
EU1522	7368	1244/1523/ 1988	1897 (Eligible – partial mitigation)
EU1533	7420	1244/1527	Eligible
EU1786	10547	1509	Eligible
EU2064	10507	1527/1642	Eligible
EU2432	11601	1800	Eligible
EU2433	11602		Not eligible
EU2452	11641	1800/1988	Eligible
	11624	P-III	Eligible
	11167		Not eligible

[1]Mining and exploration activities within the CESA have resulted in cumulative impacts to cultural resources. Recent re-evaluations of many of the remaining cultural resources within the Barrick Goldstrike POO boundary have shown that some of the historic properties that should have been avoided under the PA have been damaged or destroyed.

Source: Fawcett 2008

Table D-3 Mitigated Sites in the Cumulative Effects Study Area

Mine Name	Report Title	Author, Date	BLM Report Number	Sites Mitigated
Barrick Goldstrike Mines	Archaic and Numic Encampment in the Little Boulder Basin, Eureka County, Nevada	Tipps, B. 1988	BLM1-1188(P)	26EU1319/CrNV-12-5588 26EU1320
Barrick Goldstrike Mines	Open Site Archeology in Little Boulder Basin: 1993-1994 Data Recovery Excavations in the North Block Tailings Impoundment Area, North-Central Nevada	Schroedl, A. 1996	BLM1-1614(P)	26EK4687/CrNV-12-7400 26EK4690/CrNV-12-7229 26EK4695/CrNV-12-7401 26EK4696/CrNV-12-7402 26EK5374/CrNV-12-10545 26EU1482/CrNV-12-5664 26EU1483/CrNV-12-7421 26EU1530/CrNV-12-7240 26EU1531/CrNV-12-7407 26EU1534/CrNV-12-5665 26EU1667/CrNV-12-7146 26EU1904/CrNV-12-8926 26EU1906/CrNV-12-8249
Barrick Goldstrike Mines	Data Recovery at the Yaha Site: An Open Prehistoric Camp Site Along Rodeo Creek, Northern Eureka County, Nevada	LaFond, A. 1995	BLM1-1683(P)	26EU1997/CrNV-12-11148
Barrick Goldstrike Mines	Depression Era Quicksilver Mining in Little Boulder Basin: Data Recovery Excavations at Site 26EU1523	Jones, J. 1994	BLM1-1849(P)	26EU1523/CrNV-12-7381
Barrick Goldstrike Mines	Data Recovery Excavations at Site 26EU1494	LaFond, A. 1995	BLM1-2020(P)	26EU1494/CrNV-12-7303
Barrick Goldstrike Mines	Open Site Archeology in Little Boulder Basin: 1992 Data Recovery Excavations in the North Block Heap Leach Facility Area, North-Central Nevada	Schroedl, A. 1995	BLM1-2021(P)	26EU1529/CrNV-12-7404 26EU5200/CrNV-12-8928 26EU1581/CrNV-12-8929 26EU1524/CrNV-12-7382 26EU1734/CrNV-12-5681 26EU1320/CrNV-12-5682
Barrick Goldstrike Mines	Data Recovery Excavations at the Santa Fe Site, Eureka County, Nevada	Schroedl, A. 1994	BLM1-2450(P)	26EU1595/CrNV-12-8185

Table D-3 Mitigated Sites in the Cumulative Effects Study Area

Mine Name	Report Title	Author, Date	BLM Report Number	Sites Mitigated
Barrick Goldstrike Mines	Test Excavation of 5 Sites in Barrick Goldstrike's Expansion, Little Boulder Basin	SWCA 2007	BLM1-2594(P)	26EU1548/CrNV-12-7446 26EU1539/CrNV-12-7426 26EU2126/CrNV-12-11124 26EU2064/CrNV-12-10507 26EU1533/CrNV-12-7420
Barrick Goldstrike Mines	Data Recovery Excavations at Site 26EK4688, Elko County, North-Central Nevada	Birnie, R. 2001	BLM1-2159(P)	26EK4688/CrNV-12-7228
Barrick Goldstrike Mines	Data Recovery Excavations at Site 26EK6487, Elko County, North-Central Nevada	Birnie, R. 2000	BLM1-2052(P)	26EK6487/CrNV-12-9196
Barrick Goldstrike Mines	Report Pending			26EU1785/CrNV-12-10546
Dee Gold Mine	1996 Open Site Archaeology Near Upper Boulder Creek: Data Recovery Excavations at Site 26EK5270, EK5271, and EK5274	Tipps, B. 1996	BLM1-1753(P)	26EK5270/CrNV-12-10440 26EK5271/CrNV-12-10441 26EK5274/CrNV-12-10444
Newmont Genesis/Blue Star Area	Data Recovery Excavations at Site 26EU1505, Eureka County, Nevada	Tipps, B. Stratford, M. 1996	BLM1-1574(P)	26EU1505/CrNV-12-7324
Newmont Genesis/Blue Star Area	Data Recovery Excavations at Site 26EU2124 (CrNV-12-11122)	Stratford, M. 1995	BLM1-2446(P)	26EU2124/CrNV-12-11122
Newmont Genesis/Blue Star Area	Data Recovery Excavations at Site 26EU6232	Schroedl, A. 1996	BLM1-2447(P)	26EU6232
Newmont Genesis/Blue Star Area	Surface Collection, Mapping, and Testing of Site 26EK5278 (CrNV-12-10448)	Schroedl, A. Tallman, D. 1997	BLM1-2448(P)	26EK5278/CrNV-12-10448
Newmont Genesis/Blue Star Area	Two Penny Ridge: Numic Occupation Along Boulder Creek	Schroedl, A. Kenzle, S. 1997	BLM1-2449(P)	26EK6231/CrNV-12-12026
Newmont Genesis/Blue Star Area	Reassessment of Site Significance for CRNV-12-10801	Hockett, B. 2006	BLM1-2555(P)	CrNV-12-10801

Table D-3 Mitigated Sites in the Cumulative Effects Study Area

Mine Name	Report Title	Author, Date	BLM Report Number	Sites Mitigated
Newmont South Operations Area	An Evaluation of Six Archaeological Sites in the James Creek Vicinity, Eureka County, Nevada	Clerico et al. 1983	BLM1-727(P)	26EU839/CrNV-12-3285 26EU840/CrNV-12-3304 26EU841/CrNV-12-3305 26EU842/CrNV-12-3309 26EU844/CrNV-12-3326 James Creek Shelter Tested (26EU843/CrNV-12-3320)
Newmont South Operations Area	The Archaeology of James Creek Shelter	Elston, R. Budy, E. 1990	BLM1-1584(P)	26EU843/CrNV-12-3320 – James Creek Shelter
Newmont South Operations Area	Spring Site Archaeology in the Lower Maggie Creek Area: Data Recovery Excavations at 3 Sites Along Simon Creek	Tipps, B. 1996	BLM1-1773(P)	26EU2181/CrNV-12-11421 26EU2182/CrNV-12-11422 26EU2183/CrNV-12-11725
Newmont South Operations Area	Data Recovery Excavations at Site 26EU2184: A Multicomponent Spring Site in the Lower Maggie Creek Area	Tipps, B. 1997	BLM1-1756(P)	26EU2184/CrNV-12-11428
Newmont Bootstrap Area	Open Site Archaeology: 1996 Bootstrap Data Recovery Excavations	Schroedl, A. 1998	BLM1-1897(P)	26EU1487/CrNV-12-7345 26EU1492/CrNV-12-7440 26EU1520/CrNV-12-7364 26EU1522/CrNV-12-7368
Newmont High Desert	Mitigation of Site 26EU2505[1]	Birnie, R. 2007	BLM1-2608(P)	26EU2505/CrNV-12-12466

[1]Site inadvertently damaged that required subsequent mitigation.

Total number of sites mitigated: 57.

Source: Fawcett 2008.

SPECIAL STATUS SPECIES

APPENDIX E

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
MAMMALS				
Pallid bat *Antrozous pallidus*	BLM; NV-SP	Range: Throughout Nevada. Habitat: Found in a variety of habitats from desert scrub to forests. Roosts in a variety of structures including mines, caves, buildings and trees. Intolerant of roosts in excess of 40°C.	High. This species has been documented southwest of the study area along Rock Creek. Suitable foraging habitat occurs within the study area.	No
Townsend's big-eared bat *Corynorhinus townsendii*	BLM; NV-SPS	Range: Throughout Nevada. Habitat: Highly associated with caves and mines. Very susceptible to disturbance at roost sites. Periodically moves to alternate roosts and actively forages and drinks throughout the winter. Typically forages in open forest habitats.	High. This species has been documented east of the study area at abandoned mine shafts in the Lynn Creek drainage. Suitable foraging habitat occurs within the study area.	No
Big brown bat *Eptesicus fuscus*	BLM	Range: Throughout Nevada. Habitat: Found in a variety of habitats including forests, shrublands, and agricultural and urban areas. Roosts in a variety of structures including mines, caves, buildings and trees. More tolerant of human habitation than other bat species. Roosts in groups up to several hundred individuals.	High. This species has been documented northeast of the study area at Sugarloaf Butte. Suitable foraging habitat occurs within the study area.	No

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
Silver-haired bat *Lasionycteris noctivagans*	BLM	Range: Throughout Nevada but occurs primarily in forest and riparian habitats. Habitat: A forest associated species often found at higher elevations in pinyon-juniper, subalpine fir, aspen and willow habitats. Roosts almost exclusively in trees in the summer. Frequently alternates roost sites. Maternity roost sites are usually in woodpecker holes.	None.	Yes. No suitable habitat occurs within the study area.
Western red bat *Lasiurus blossevilli*	BLM; NV-SPS	Range: Known from only a few locations in Nevada in Lincoln and Clark counties. Habitat: Found primarily in wooded habitats. Species is a solitary rooster in trees and under leaf litter. Originally thought to only be a migrant in Nevada but small breeding populations may exist in the Fallon and Muddy River areas.	Moderate: Marginal foraging habitat occurs within the study area; however, this species was found during baseline surveys.	No
Hoary bat *Lasiurus cinereus*	BLM	Range: Patchy distribution throughout Nevada. Habitat: Tree-associated species. Found primarily in forested upland habitats, as well as in forest riparian zones, and agriculture habitats. May occur in park and garden settings in urban areas. A solitary rooster that typically roosts in trees.	Low. Marginal foraging habitat occurs within the study area.	No

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
California myotis *Myotis californicus*	BLM	Range: Throughout Nevada but mainly found in the southern half of the state at lower elevations. Habitat: Found in a variety of habitats from desert scrub to forests. Roosts in a variety of structures including mines, caves, buildings, and trees. Actively forages throughout the winter.	High. Suitable foraging habitat occurs within the study area.	No
Small-footed myotis *Myotis ciliolabrum*	BLM	Range: Throughout Nevada. Habitat: Found in a variety of habitats from desert scrub to pine-fir forests. Roosts in caves, mines and trees. Forages in open areas.	High. This species was detected south of the study area at the Newmont Mine. Suitable foraging habitat occurs within the study area.	No
Long-eared myotis *Myotis evotis*	BLM	Range: Throughout Nevada, primarily at higher elevations. Habitat: Primarily a forest-associated species. Roosts in caves, mines and under bridges. May forage within mine and cave structures, gleaning moths from the rock walls.	High. This species has been documented northeast of the study area at Sugarloaf Butte and southwest of the study area along Rock Creek. Suitable foraging habitat occurs within the study area.	No
Little brown myotis *Myotis lucifugus*	BLM	Range: Found primarily in the northern part of Nevada. Habitat: Found at higher elevations in coniferous forest. Requires a nearby water source. Roosts in trees, buildings, caves, and mines. One of the species most commonly found in human structures.	Low. Marginal foraging habitat occurs within the study area.	No

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
Long-legged myotis *Myotis volans*	BLM	Range: Throughout Nevada but absent from the low desert. Habitat: Piñon-juniper and other higher elevation forest habitats. Night roosts and hibernacula located in caves and mines. Forages in open areas at canopy height.	High. This species has been documented northeast of the study area at Sugarloaf Butte. Suitable foraging habitat occurs within the study area.	No
Yuma myotis *Myotis yumanensis*	BLM	Range: Found in the western, southern and north-central part of Nevada. Habitat: Found in a wide variety of habitats from low to mid-elevations, including sagebrush, salt desert scrub, agriculture, playa, and riparian habitats. One of the species that is most tolerant of human habitation and one of the few that thrives in a relatively urbanized environment. Roosts in building, trees, mines, caves, bridges and other man-made structures.	High. Suitable foraging habitat occurs within the study area.	No
Western pipistrelle bat *Pipstrellus hesperus*	BLM	Range: Throughout most of Nevada. More common in the western and southern portions. Habitat: Lower and Upper Sonoran desert habitats of blackbrush, creosote, salt desert shrub and sagebrush, with occasional occurrence in Ponderosa pine and pinyon-juniper, usually in association with rock features such as granite boulders and canyons. Roosts in mainly in rock crevices.	High. This species has been documented southwest of the study area along Rock Creek. Suitable foraging habitat occurs within the study area.	No

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
Brazilian free-tailed bat *Tadarida braziliensis*	BLM; NV-SP	Range: Throughout Nevada. Habitat: Found in a wide variety of habitats from desert scrub to coniferous forests. Roosts in caves, mines, trees, bridges, and buildings. Colonies often number in the thousands.	Moderate. This species has not been documented in the project region. However, suitable foraging habitat occurs within the study area.	No
Preble's shrew *Sorex preblei*	BLM	Range: Northern and western Nevada. Habitat: Found in a variety of habitats including arid grassland and shrubland, forest edges, alpine tundra, and wetlands.	High. Suitable habitat occurs within the study area.	No
Pygmy rabbit *Brachylagus idahoensis*	BLM	Range: Throughout Nevada but limited to areas dominated by sagebrush. Habitat: Requires dense sagebrush for cover as well as appropriate soils for burrowing (i.e., high clay content). Often found in drainages with taller sagebrush present.	High. The study area contains suitable sagebrush habitat.	No
Fletcher dark kangaroo mouse *Microdipodops megacephalus nasutus*	BLM; NV-SPS	Range: Throughout Nevada. Habitat: Intermountain desert scrub, sagebrush, grasslands and meadows, badlands and dunes, desert playas, and ephemeral pools.	High. Suitable habitat occurs within the study area.	No

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
River otter *Lontra canadensis*	BLM	Range: Northeastern to central-western Nevada. Habitat: Riverine systems and associated marshes, lakes, and ponds.	None.	Yes. No suitable habitat occurs within the study area. The nearest documented records occur along the Humboldt River.
BIRDS				
Least bittern *Ixobrychus exilis*	BLM	Range: Nests on shallow lakes and wetlands from Sheldon NWR to Ruby Lakes NWR south to Mason Valley WMA in western Nevada. Habitat: Prefers marshes in very fresh water, typically characterized by cattail and/or spikerush. Breeding period is April 15-July 15.	Low. Marginal habitat occurs within the study area.	No
Bald eagle *Haliaeetus leucocephalus*	NV-E	Range: Throughout Nevada. Habitat: Generally nests and roosts in close proximity to large water bodies including rivers, lakes, and reservoirs. Breeding period is February 15-July-15.	Moderate: Occurrence would be limited to migrating and foraging individuals.	No
Northern goshawk *Accipiter gentilis*	BLM; NV-SPS	Range: Limited to the northern two-thirds of Nevada. Habitat: Deep conifer-dominated mixed forests. May exhibit seasonal migrations depending on prey availability. Preferred nesting habitat is aspen stands along perennial streams. Breeding period is April 15-August 1.	None.	Yes. No suitable habitat occurs within the study area.

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
Swainson's hawk *Buteo swainsoni*	BLM	Range: Found throughout Nevada, typically in agricultural areas. Habitat: Agricultural valleys and associated uplands. Nests in large shrubs and trees such as cottonwood, willows and aspen. Breeding period is April 1-July 15.	High. Suitable foraging habitat occurs within the study area. No known nests occur within the study area.	No
Ferruginous hawk *Buteo regalis*	BLM	Range: Throughout Nevada mainly in sagebrush grasslands. Habitat: Dry, open country. Nests usually occur in trees at the interface between piñon-juniper and sagebrush grasslands. Forages over sagebrush grasslands. Breeding period is March 15-July 15.	High. Suitable foraging habitat occurs within the study area. No known nests occur within the study area.	No
Golden eagle *Aquila chrysaetos*	BLM	Range: Throughout Nevada. Habitat: Mountain or hilly terrain. Nests usually occur on cliffs or in trees. Forages in open country. Breeding period is March 15-July 15.	High. This species has been seen flying near the study area. Suitable foraging habitat occurs within the study area. This species has been documented nesting southwest of the study area along Rock Creek.	No
Peregrine falcon *Falco peregrinus*	BLM; NV-E	Range: Southwest and extreme southeast Nevada. Habitat: Open country near cliffs. Typically migrates south of U.S. during winter months. Nests on cliffs and rock ledges. Forages in open areas. Breeding period is March 15-July 15.	Low. Marginal foraging habitat is found within the study area.	No

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
Prairie falcon *Falco mexicanus*	BLM	Range: Throughout Nevada. Habitat: Dry, open country including desert scrub and sagebrush grasslands. Usually nests on cliffs in proximity to suitable foraging habitat. Breeding period is March 15-July 15.	High. Suitable foraging habitat is found within the study area. This species has been documented nesting southwest of the study area along Rock Creek.	No
Greater sage-grouse *Centrocercus urophasianus*	BLM	Range: Throughout Nevada in areas with sagebrush. Habitat: Sagebrush grasslands. Leks are located in open areas in close proximity to escape cover. Nests are located in sagebrush habitat, typically within 2 miles of the lek. Broods are raised in wet, grassy areas near sagebrush. Winter habitat consists of south and east facing slopes with minimal snow cover. Breeding period (including displaying, nesting, and fledging) is March 1-July 31.	High. Historically, three leks occurred immediately within the project vicinity. However, two of these leks have been consumed by the Goldstrike Mine in recent years. The third lek is 1.5 miles north of the study area and has not been active since 1989. The nearest active lek occurs approximately 5.5 miles north of the study area. Suitable habitat occurs within the study area.	No

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
Sandhill crane *Grus canadensis*	BLM	Range: Breeds in the lower river valleys and interior basins of the northeastern and east-central regions of Nevada. Habitat: Large irrigated hay meadows, flooded pastures, and grasslands. Also found in agricultural grain fields certain times of the year. Approximately 90 percent of nesting crane pairs is found in Elko County with additional nesting pairs in White Pine, Eureka, Lander, northern Lincoln and Nye, and eastern Humboldt counties. Breeding period is April 15-July 15.	Low. Marginal habitat occurs within the study area.	No
Long-billed curlew *Numenius americanus*	BLM	Range: A confirmed breeder at Sheldon NWR in northern Washoe County, Ruby Lake NWR in Elko County, Lahontan Valley in Churchill County, and Fish Creek Ranch in Eureka County. Habitat: Prefer closely cropped grasslands, pastures, wet or dry meadows, either on the fringe of a marsh or in a meadow or broad riverine floodplain such as the Humboldt River. Non-breeding feeding areas include irrigated pastures and croplands, shallow wetlands, and newly plowed fields. Breeding period is April 15-July 15.	Low. Marginal habitat occurs within the study area.	No

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
Black tern *Chlidonias niger*	BLM	Range: Nests on shallow lakes and wetlands from Sheldon NWR to Ruby Lakes NWR south to Mason Valley WMA in western Nevada. Habitat: Prefers marshes in very fresh water, typically characterized by cattail and/or spikerush. Breeding period is April 15-July 15.	Low. Marginal habitat occurs within the study area.	No
Burrowing owl *Athene cunicularia hypugea*	BLM	Range: Throughout Nevada. Habitat: Open country from desert scrub to grasslands. Often found in or around prairie dog colonies. Nests in burrows. Breeding period is April 15-August 15.	High. Suitable foraging habitat occurs within the study area. No known nests have been recorded within the study area.	No
Long-eared owl *Asio otus*	BLM	Range: Throughout Nevada. Found primarily at higher elevations. Habitat: Juniper woodlands, riparian forests, and coniferous forests. Will often take over old hawk, crow or magpie nests. Breeding period is February 15-July 15.	High. Suitable foraging habitat occurs within the study area. However, roosting and nesting habitat is lacking within the study area.	No
Short-eared owl *Asio flammues*	BLM	Range: Throughout Nevada. Habitat: Open country from desert-scrub to sagebrush-grasslands. Nests and roosts on the ground. Forages primarily at dawn and dusk. Breeding period is February 15-July 15.	High. Suitable nesting and foraging habitat occurs within the study area.	No

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
Lewis's woodpecker *Melanerpes lewis*	BLM	Range: A resident breeder in isolated pockets mainly in the northern half of the state. Habitat: During the breeding season, this species prefers open habitats that facilitate its foraging behavior of hawking for insects. This species nest primarily in riparian woodlands. Furthermore, this species prefers areas with a grassy and bushy understory. Breeding period is April 15-July 15.	None.	Yes. No suitable habitat occurs within the study area.
Pinyon jay *Gymnorthinus cyanocephalus*	BLM	Range: Throughout Nevada. Habitat: Piñon-juniper woodlands. Less frequently found in pine forests and sagebrush grasslands. Distribution is determined by availability of food resources. Nests in loose colonies. Breeding period is April 15-July 15.	None.	Yes. No suitable habitat occurs within the study area.
Juniper titmouse *Baeolophus griseus*	BLM	Range: Found mainly in piñon-juniper woodlands from Interstate 80 south to the Colorado River. Habitat: Strongly associated with pinyon-juniper woodlands. Snags and heart rot are assumed to be important in providing nesting cavities. Dense foliage and closed canopies are preferred, while thin understory and ground cover are preferred for feeding activities. Breeding period is April 15-July 15.	None.	Yes. No suitable habitat occurs within the study area.

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
Loggerhead shrike *Lanius ludovicianus*	BLM; NV-SPS	Range: Throughout Nevada. Habitat: Open country including desert scrub and sagebrush grasslands. Nests and forages in brushy areas. Breeding period is April 15-July 15.	High. Suitable nesting and foraging habitat occurs within the study area.	No
Yellow-breasted chat *Icteria virens*	BLM	Range: Throughout Nevada although more common in the eastern portion of the state. Habitat: Found in cottonwood, willow, riparian and other woodland habitats. Prefer dense understories. Breeding period is April 15-July 15.	Low. Marginal habitat occurs within the study area.	No
Vesper sparrow *Pooecetes gramineus*	BLM	Range: Nesting has been recorded only in the northern half of Nevada. However, the higher mountain ranges in southern Nevada may provide nesting habitat for the species as well. Habitat: Nests in various open shrub habitats from high elevation valleys to higher mountain slopes and basins. Breeding period is April 15-July 15.	High. Suitable nesting and foraging habitat occurs within the study area.	No

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
Black rosy-finch *Leucosticte atrata*	BLM	Range: Breeds on the highest mountains of Elko and White Pine counties. Habitat: Breeds and nests in alpine tundra habitat. Nests on high ridges and peaks (9,000 to 13,000 feet in elevation) near rock cover, usually in crevices and holes in cliff sides. Breeding period is May 1-July 15.	None.	Yes. No suitable habitat occurs within the study area.
AMPHIBIANS				
Columbia spotted frog *Rana luteiventris*	FC; NV-SP	Range: Central (Nye County) and northeast (Elko and Eureka Counties), usually at elevations between 5,600 and 8,700 feet. Habitat: Quiet aquatic habitats including perennial streams, ponds, springs, lakes and marshes. May travel to uplands during wet weather. Females typically lay eggs in late April and May. Tadpoles develop into frogs from late summer to late fall.	Moderate. Known populations exist in the Independence Range to the east of the study area. No known records of this species exist for the study area, although marginal habitat occurs along Boulder Creek.	No

Table E-1 Special Status Species Identified for the Betze Pit Expansion Project

Common Name/ Scientific Name	Status[1]	Range Habitat Requirements	Potential for Occurrence on or Near the Study Area	Eliminated from Detailed Analysis
Northern leopard frog *Rana pipiens*	BLM; NV-SP	Range: Isolated habitats throughout Nevada. Absent from the southwest portion of the state. Habitat: Springs, slow streams, marshes, bogs, ponds, canals, flood plains, reservoirs, and lakes; usually permanent water with rooted aquatic vegetation. In summer, commonly inhabits wet meadows and fields. Females typically lay eggs in late April and May. Tadpoles develop into frogs from late summer to late fall.	Moderate. No known records of this species exist for the study area, although marginal habitat occurs along Boulder Creek.	No

[1]Status:

FT – Federally Threatened Species

FC – Federal Candidate Species

BLM – BLM Sensitive Species

NV-SP – Nevada State Protected

NV-SPS – Nevada State Protected Sensitive

Source: AGFD 1993; Birds of North America Online 2007; BLM 2007a,b,c,d; BLM 2005, 2002a, 2000a,b; BLM 1991a,b; Bradley et al. 2006; Floyd et al. 2007; Hall 1995; Harvey et al. 1999; Herron et al. 1985; JBR 1996; Johnsgard 1990; Lamp 2007a,b; NatureServe Explorer 2007; Neel 1999; NDOW 2007a; NGS 1983; NNHP 2007; USFWS 2007a,b; USFWS MPR 2007; WAPT 2006.

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